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THE DEVELOPMENT OF A SOFTWARE DEDICATED TO SOLVING THE FUZZY LINIAR PROGRAMS

Abstract: *A fuzzy linear program is a linear program in which the input parameters are mathematically modeled with fuzzy numbers. The benefit vector, the unknown vector, the constraint matrix, and the free terms vector composing a fuzzy linear program, all have fuzzy number components.*

The article develops algorithmic steps with which one can make a software for solving fuzzy linear programs. Even if the triangular fuzzy numbers were used in the example presented, the algorithm is valid for all polygonal fuzzy numbers.

In practice elementary fuzzy numbers such as rectangular, triangular and trapezoidal fuzzy numbers can be used; the medium fuzzy numbers such as the hexagonal and octagonal fuzzy numbers or the large fuzzy numbers such as the decagonal, dodecagonal, fuzzy numbers can also be used.

By using fuzzy numbers in linear programming, answers are provided to practical problems in a more realistic manner.

Key words: *linear programming, simplex algorithm, triangular fuzzy numbers.*

JEL: *D81, M15*

Elementary arithmetic operations on the set of triangular fuzzy numbers

Since the mid-twentieth century, the specialized literature in the field of fuzzy theory and applications in economics has gained a special foothold.

We will mention here a limited number of papers with a special impact in the field, works from which one can consult many other notions of the fuzzy theory: [Kaufmann, 1973], [Negoiţă, 1974] [Moisil, 1975], [Vlădeanu, 2004], [Bojadziev, 2006] and [Gherasim, 2014].

A ***triangular fuzzy number*** is an ordered triplet of real numbers:

$$\widetilde{a} = (a_1, a_2, a_3),\ a_1 \le a_2 \le a_3 \tag{1}$$

The indicators associated with ***a triangular fuzzy number*** $\widetilde{a} = (a_1, a_2, a_3)$ are defined as follows:

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the core and middle of support	$a_N = a_2\,; \qquad a_{Sp} = \dfrac{a_1 + a_3}{2}$
the length of the support	$L_a^{Sp} = a_3 - a_1$
the center of gravity	$a_G = <\tilde{a}> = \dfrac{a_1 + 2\cdot a_2 + a_3}{4}$
the sign	$\delta_a = \begin{cases} \text{sign}(a_G) & , a_G \neq 0 \\ \text{sign}(a_N) & , a_G = 0 \end{cases}$

(2)

Defining some arithmetic operations on the set of the triangular fuzzy numbers that retain associated indicators leads to major advantages.

The* basic *arithmetic operations* with *triangular fuzzy numbers [Gherasim, 2014] are performed based upon the following relations:

$$\tilde{a} = (a_1, a_2, a_3),\ \tilde{b} = (b_1, b_2, b_3) \quad , \tilde{a}, \tilde{b} \in \mathbf{F}_{tr}$$

Scalar multiplication	$t\tilde{a} = \begin{cases} (ta_1, ta_2, ta_3) & , t \geq 0 \\ (ta_3, ta_2, ta_1) & , t < 0 \end{cases}$
Addition and Subtraction	$\tilde{a} + \tilde{b} = (a_1 + b_1, a_2 + b_2, a_3 + b_3)\,;$ $\tilde{a} - \tilde{b} = (a_1 - b_3, a_2 - b_2, a_3 - b_1)$
Multiplication and Division	$\tilde{a}\tilde{b} = \dfrac{a_G \cdot \tilde{b} + \tilde{a} \cdot b_G}{2}\,; \quad \dfrac{\tilde{a}}{\tilde{b}} = \dfrac{a_G \cdot \tilde{b} + \tilde{a} \cdot b_G}{2 \cdot b_G^2}\ ,(\forall) b_G \neq 0$

(3)

The ordering of triangular fuzzy numbers is obtained by successively and exclusively applying four ordering criteria:

$$\begin{aligned} &\text{O1:} && a_G < b_G \Rightarrow \tilde{a} \prec \tilde{b} \\ &\text{O2:} && a_N < b_N \Rightarrow \tilde{a} \prec \tilde{b} \\ &\text{O3:} && \delta_a \cdot L_a^{Sp} < \delta_b \cdot L_b^{Sp} \Rightarrow \tilde{a} \prec \tilde{b} \\ &\text{O4:} && L_a^{Sp} < L_b^{Sp} \Rightarrow \tilde{a} \prec\prec \tilde{b} \end{aligned}$$

(4)

Example of operations with triangular fuzzy numbers:

Let us consider the triangular fuzzy numbers: $\tilde{a} = (5, 8, 11)$, $\tilde{b} = (4, 9, 10)$ şi $\tilde{c} = (0, 9, 10)$.

$$<\tilde{a}> = \frac{5 + 2\cdot 8 + 11}{4} = \frac{32}{4} = 8 \qquad <\tilde{b}> = \frac{4 + 2\cdot 9 + 10}{4} = \frac{32}{4} = 8 = <\tilde{a}>$$

The weight center criterion (O1) does not decide on the order of the fuzzy numbers $\tilde{a}$ and $\tilde{b}$.

The criterion O2 (comparison of peaks) is applied:

$$a_N = 8 < 9 = b_N \Rightarrow \tilde{a} \prec \tilde{b} \qquad (5,8,11) \prec (4,9,10)$$

$$< \tilde{c} > = \frac{0+2\cdot 9+10}{4} = \frac{28}{4} = 7 < 8 = < \tilde{a} > = < \tilde{b} > \Rightarrow \tilde{c} \prec \tilde{a} \ \wedge \ \tilde{c} \prec \tilde{b}$$

$$\tilde{c} \prec \tilde{a} \prec \tilde{b} \qquad (0,9,10) \prec (5,8,11) \prec (4,9,10)$$

$$\tilde{a} + \tilde{b} = (5+4, 8+9, 11+10) = (9,17,21) \quad < \tilde{a} + \tilde{b} > = \frac{9+2\cdot 17+21}{4} = 16 = 8+8 = < \tilde{a} > + < \tilde{b} >$$

$$\tilde{a} - \tilde{b} = (5-10, 8-9, 11-4) = (-5,-1,7), \quad < \tilde{a} - \tilde{b} > = \frac{-5+2\cdot(-1)+7}{4} = 0 = < \tilde{a} > - < \tilde{b} >$$

$$\tilde{a} \cdot \tilde{b} = \frac{8\cdot(5,8,11)+8\cdot(4,9,10)}{2} = \frac{(40,64,88)+(32,72,80)}{2} = \frac{(72,136,168)}{2} = (36,68,84)$$

$$< \tilde{a} \cdot \tilde{b} > = \frac{36+2\cdot 68+84}{2} = 64 = 8\cdot 8 = < \tilde{a} > \cdot < \tilde{b} >$$

$$\frac{\tilde{a}}{\tilde{b}} = \frac{\tilde{a}\cdot\tilde{b}}{< \tilde{b} >^2} = \frac{(36,68,84)}{8^2} = \left(\frac{9}{16}, \frac{17}{16}, \frac{21}{16}\right), \quad \left\langle \frac{\tilde{a}}{\tilde{b}} \right\rangle = \frac{\frac{9}{16}+2\cdot\frac{17}{16}+\frac{21}{16}}{4} = \frac{64}{64} = 1 = \frac{8}{8} = \frac{< \tilde{a} >}{< \tilde{b} >}$$

Solving the linear programs (PL) by the Simplex algorithm with the penalty method

The linear programming has emerged as a distinct scientific discipline in the middle of the last century.

The first papers with a uniform and complete treatment were published by L. Kantorovici (1939) and F. Hitchcock (1941). In 1947 G. Dantzig and J. Von Newmann created the simplex method for solving linear programming problems.

Amongst the first reference works in the field of linear programming at international level we mention: [Baumol, 1963], [Dantzig, 1963] and [Gass, 1958].

In Romania, entire generations of professors and researchers approached the field of linear programming. Chronologically, we mention the volumes of: Boroş, 1970], [Mihoc, 1973], [Maliţa, 1975], [Drăgan, 1976], [Boldur, 1979], [Cerchez, 1982], [Purcaru, 1982] etc.

A ***linear program (PL)*** is composed of three groups of mathematical relations:

$$(PL) \quad \left| \begin{array}{l} \text{(a)} \quad [\min/\max]\ z_{(C,X)} = c_1x_1 + c_2x_2 + \ldots + c_nx_n \\ \hline \text{(b)} \quad \begin{cases} a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n \le d_1 \\ a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n = d_2 \\ a_{31}x_1 + a_{32}x_2 + \ldots + a_{3n}x_n \ge d_3 \quad \ldots \\ a_{m1}x_1 + a_{m2}x_2 + \ldots + a_{mn}x_n \underset{\ge}{\overset{\le}{=}} d_m \end{cases} \\ \text{(c)} \quad x_j \ge 0 \ , (\forall) j = \overline{1,n} \end{array} \right. \qquad (5)$$

The relation (a) contains ***the objective function*** of optimization $\mathbf{z_{(C,X)}}$ composed with ***the benefit vector*** $\mathbf{C} = (c_1, c_2, ..., c_n)$ and ***the unknown vector*** $\mathbf{X^T} = (x_1, x_2, ..., x_n)$.

The second group of relations (b) represents the restrictions imposed on the unknown to be determined and contains the ***matrix of restrictions*** $\mathbf{A} = (a_{ij})_{i=\overline{1,m}, j=\overline{1,n}}$ and the ***free terms vector*** $\mathbf{D^T} = (d_1, d_2, ..., d_m)$. The relations (c) are ***the conditions of non-negativity*** imposed on the unknown.

Solving a linear program (PL) consists of determining the positive values $x_j \geq 0$ (c) that comply with the restrictions (b) and optimizing the value $z_{(C,X)}$ of the objective function (a).

Among the many methods for solving linear programming problems (PL), the "***Simplex algorithm***" method was aggressively imposed, a method presented in detail in most of the aforementioned specialized volumes.

The general method of solving a linear program, called ***the simplex algorithm*** with ***the penalty method***, will be presented briefly with algorithmic steps.

Step 1. Obtaining ***a*** minimum ***initial admissible primary program***

- The first action from this step involves ***converting the optimum from maximum to minimum*** (if applicable). Thus, if we note $w = -z$ and calculate $w^* = \min w$ then $z^* = \max z = -w^*$. Therefore, in the linear program we will have either an initial $[\min]z$ or $[\min]w$.
- The second action involves ***changing the sign of the negative free terms*** $d_i < 0$ (if any), by multiplying both members of the respective restrictions by –1 (an action which reverses the meaning of inequality $\leq \longleftrightarrow \geq$).
- The third action involves ***the transformation of the inequality restrictions into the equality restrictions*** by adding to the inequalities $\leq$ the decrease to the inequalities respectively $\geq$ of a positive variable aslo called ***deviation variables***.
- The fourth action, also called ***the penalty method***, generates an initially ***allowable solution***, by adding a ***penalty variable*** to each restriction (the deviation variables with the positive sign also play the role of penalty variables)

$$\text{(PPA)} \quad \left| \begin{array}{l} \min z = c_1x_1 + c_2x_2 + ... + c_nx_n + M \cdot (x_{n+k+1} + x_{n+k+2} + ... + x_{n+k+m}) \\ \hline \begin{cases} a_{11}x_1 + a_{12}x_2 + ... + a_{1n}x_n + x_{n+1} + x_{n+k+1} = d_1 \\ a_{21}x_1 + \tilde{a}_{22}\tilde{x}_2 + ... + a_{2n}x_n - x_{n+2} + x_{n+k+2} = d_2 \\ ... \\ a_{m1}x_1 + a_{m2}x_2 + ... + a_{mn}x_n + x_{n+k+m} = d_m \end{cases} \\ x_j \geq 0 \ , \forall j = \overline{1, n+k+m}; \quad b_i \geq 0 \ , \forall i = \overline{1, m} \end{array} \right. \tag{6}$$

In the objective function, the most m variables added have ***a high enough penalty coefficient*** $M > 0$. For example, M can be chosen as follows:

$$A_{max} = \max_{\substack{i=\overline{1,m}\\ j=\overline{1,n}}} |a_{ij}|, \qquad C_{max} = \max_{j=\overline{1,n}} |c_j|, \qquad D_{max} = \max_{i=\overline{1,m}} |d_i|, \qquad M \geq A_{max} + C_{max} + D_{max}.$$

The last m columns of the restrictions form the unit matrix $I_{m\times m}$.

The classical linear program (6) is a minimum allowable primary program (PPA).

Step 2. Obtaining the initial Simplex table S_0

Now the constraint matrix contains n+k+m columns: $\tilde{\mathbf{A}} = (\tilde{a}_{ij})_{\substack{i=\overline{1,m}\\ j=\overline{1,n+k+m}}}$.

The program (PPA) in relations (6) contains a first ***allowable basic solution*** in which the first n+k variables are null (called ***additional variables***) and the last m variables (called ***basic variables***) are equal to the free terms:

$$\begin{cases} x_1 = 0 = x_2 = ... = x_{n+k} \\ x_{n+k+1} = d_1,\ x_{n+k+2} = d_2,\ \ ...\ ,\ x_{n+k+m} = d_m \end{cases} \tag{7}$$

For the admissible solution (7) the objective function has the value:

$$z = M \cdot (d_1 + d_2 + ... + d_m) = M \cdot \sum_{i=1}^{m} d_i \tag{8}$$

The ***simplex table*** associated with the program (PPA) in the relations (6) is the matrix $\mathbf{S} = (s_{ij})_{\substack{i=\overline{1,m}\\ j=\overline{1,m+k+n+1}}} = (\overline{A} \mid D)$ composed of the extended matrix $\overline{A}$ (the initial matrix of the restrictions A to which the columns corresponding to the deviation variables and the penalization variables were added) and to which we have added to the right, as a last column, the vector of free terms $\mathbf{D^B}$.

For the easy algorithm calculations, the table is supplemented with another line containing the objective function coefficients.

The columns are noted (above) with the corresponding variables: $x_1, x_2, ..., x_{n+k+m}$, and the lines are named (left, in a new column **B**) with the corresponding basic variables:

Table 1

The initial simplex table S_0 associated with an allowable primary program (PPA)

B	$\mathbf{x_1}$	$\mathbf{x_2}$	**...**	$\mathbf{\downarrow x_q}$	**...**	$\mathbf{x_{n+k}}$	$\mathbf{x_{n+k+1}}$	$\mathbf{x_{n+k+2}}$	**...**	$\mathbf{x_{n+k+m-1}}$	$\mathbf{x_{n+k+m}}$	$\mathbf{D^B}$	$\mathbf{C^B}$
$\mathbf{c_j}$	c_1	c_2	...	c_q	...	c_n	M	M	M	M	M		
$\mathbf{x_{n+k+1}}$	s_{11}	s_{12}	...	s_{1q}	...	$s_{1,n+k}$	1	0	...	0	0	d_1	c_1^B=M
$\mathbf{x_{n+k+2}}$	s_{21}	s_{22}	...	s_{2q}	...	$s_{2,n+k}$	0	1	...	0	0	d_2	c_2^B=M
...	...	...	...	...	...	...	...	...	...	...	...	...	...
$\mathbf{\leftarrow x_p}$	s_{p1}	s_{p2}	...	s_{pq}	...	$s_{p,n+k}$	0	0	...	0	0	d_p	c_p^B=M

Table 1 (continued)

...	...	...	...	...	...	...	...	...	...	...	...	...	...
$\mathbf{x_{n+k+m-1}}$	s_{m-11}	s_{m-12}	...	s_{m-1q}	...	$s_{m-1,n+k}$	0	0	...	1	0	d_{m-1}	$c_{m-1}{}^{B}$=M
$\mathbf{x_{n+k+m}}$	s_{m1}	s_{m2}	...	s_{mq}	...	$s_{m,n+k}$	0	0	...	...	1	d_m	$c_m{}^{B}$=M
$\mathbf{z_i^B}$	$z_1{}^{B}$	$z_2{}^{B}$		$z_q{}^{B}$	...	...	...	...	...		...	...	
$\Delta_j = \mathbf{c_j - z_i^B}$	$c_1 - z_1{}^{B}$	$c_2 - z_2{}^{B}$		$c_q - z_q{}^{B}$	...	...	...	...	...		...	...	

The simplex table is also supplemented by a last column (on the right) containing the coefficients from the objective function corresponding to the basic variables ($\mathbf{C^B}$, has initially only M values).

Step 3. Obtaining the pivot position (p_r, q_r) in a ***Simplex table*** (initially r=0).

The column q_r and the line p_r correspond to the input variable and respectively the base output variable.

In order to determine them, the simplex table is completed with two more lines ($\mathbf{z_j^B}$ and $\Delta_\mathbf{j}$) calculated as follows:

$$z_j^B = \sum_{i=1}^{m} c_i^B \cdot s_{ij} \quad \Big| \quad ,(\forall)j = \overline{1, n+k+m+1} \tag{9}$$

$$\Delta_j = c_j - z_j^B \tag{10}$$

The component $\mathbf{z_j^B}$ in column j is obtained by cumulating the products between the values in the last column ($\mathbf{C^B}$) and those in the respective column j (S_{ij}).

The differences in the last line (Δ_j) are obtained by subtracting from the first line (the objective function line) of the previous line ($\mathbf{z_j^B}$).

$\mathbf{x_q}$ and $\mathbf{x_p}$ are established by ***the input criteria*** and ***the output in / from the base*** respectively**.**

The non-basic variable $\mathbf{x_q}$ ***enters the base*** with the smallest non-positive difference:

$$\boxed{\Delta_q = \inf_{j \in S}\{\Delta_j \le 0\}} \tag{11}$$

If ***all the differences are positive*** $(\Delta_j > 0 \ , \forall j \in S)$ then ***the*** basic ***program*** corresponding to the Simplex S_r ***is optimal*** and ***the optimal solution is unique.*** One can proceed to step 5.

If by entering the base of the variable $\mathbf{x_q}$ a previous base is repeated, then ***the program has multiple optimal solution***. One can proceed to step 5.

If the variable $\mathbf{x_q}$ enters the base, then the variable $\mathbf{x_p}$ exists with the lowest ratio:

$$\boxed{\frac{d_p}{s_{pq}} = \inf_{s_{iq}>0}\left\{\frac{d_i}{s_{iq}}\right\}, (\forall)i \in B} \tag{12}$$

If $s_{iq} \le 0$,$(\forall)i \in B$ then ***the program has infinite optimal***. STOP.

Step 4. ***Switching from the Simplex table*** S_r ***to the next Simplex*** S_{r+1}: $S_r \to S_{r+1}$

The new simplex is obtained by ***the pivoting operation*** in the simplex $\mathbf{S^{(r)}} = (s_{ij}^{(r)})_{m\times(m+k+n+1)}$ with the pivot $s_{pq}^{(r)} \neq 0$ from the position (p_r, q_r), an operation that involves the following calculations:

– the pivot line is divided by the pivot (the pivot position is set to 1):

$$\boxed{s_{pj}^{(r+1)} = \frac{s_{pj}^{(r)}}{s_{pq}^{(r)}}} \quad ,\forall j \neq q \qquad s_{pq}^{(r+1)} = 1 \tag{13}$$

– the pivot column is filled in with 0: $s_{iq}^{(r+1)} = 0$ $,\forall i \neq p$

– any other element in the table is transformed according to ***the rule of the rectangle:***

$$\boxed{s_{ij}^{(r+1)} = \frac{s_{ij}^{(r)} \cdot s_{pq}^{(r)} - s_{iq}^{(r)} \cdot s_{pj}^{(r)}}{s_{pq}^{(r)}}} \quad ,i \neq p \text{ or } j \neq q \tag{14}$$

After pivoting, in the new simplex $\mathbf{S^{(r+1)}}$ we change in column **B** the variable $\mathbf{x_p}$ with the variable $\mathbf{x_q}$ and in the last column $\mathbf{C^B}$ (on the line of $\mathbf{x_q}$) we change the coefficient with the corresponding one from the objective function (c_q).

r ($r+1 \to r$) is increased and ***one can return to step 3***.

Step 5. ***The reading of the optimal solution / solutions*** and the optimal value for the objective function, from the last simplex tables.

After having deleted from the last simplex table of all columns (keeping only two columns, **B** and $\mathbf{D^B}$) and after having deleted the first and last line (the objective function and difference line), a table of the following form is obtained:

B	$\mathbf{D^B}$
x_{1b}	d_{1u}
x_{2b}	d_{2u}
...	...
x_{mb}	d_{mu}
$\mathbf{z_j^B}$	z_u^B

The optimal solution and ***the optimal value*** are:

$$x_{1b}^* = d_{1u}, \quad x_{2b}^* = d_{2u}, \quad ..., \quad x_{mb}^* = d_{mu}, \qquad z^* = z_u^B$$

If at least one non-null non-penalty variable is entered in the last base, then ***the program has no permissible solutions*** (it was incorrectly stated).

we state that ***the algorithm cycles*** if ***the same base is obtained a second time***.

In this case, ***the program supports multiple optimal solutions.***

The last v simplex tables that have the same optimal value correspond to the v extreme optimal solutions:

$$X^{*(1)} = (x_1^{*(1)}, x_2^{*(1)}, ..., x_n^{*(1)}),\ X^{*(2)} = (x_1^{*(2)}, x_2^{*(2)}, ..., x_n^{*(2)}),\ ...,\ X^{*(v)} = (x_1^{*(v)}, x_2^{*(v)}, ..., x_n^{*(v)})$$

The general optimal solution is the convex combination of these v extreme solutions:

$$X^*(\lambda_1, \lambda_2, ..., \lambda_v) = \lambda_1 \cdot X^{*(1)} + \lambda_2 \cdot X^{*(2)} + ... + \lambda_v \cdot X^{*(v)}$$
$$\forall \lambda_k \geq 0 \text{ cu } \lambda_1 + \lambda_2 + ... + \lambda_v = 1.$$

Finally, it should be remembered that applying ***the simplex algorithm with the penalty method*** can end with one of the following four possibilities:

a. ***the program has a unique optimal solution*** if all the differences in the columns of the non-basic variables are strictly positive ($\Delta_j > 0\ , \forall j \in S$).
b. ***the program has multiple optimal solutions*** if the same basis is obtained for the second time.
c. ***the program has infinite optimum*** if x_q enters the base and $s_{iq} \leq 0$, $,(\forall) i \in B$.
d. ***the program has no admissible solutions*** if in the last base there are also non-null penalty variables.

Solving fuzzy linear programs (PLF) with modified simplex algorithm

A fuzzy linear program (PLF) is a linear program in which the coefficients of the objective function, the technological matrix components and the free terms have uncertain mathematically modeled values with fuzzy numbers (only triangular fuzzy numbers will be used below):

$$(PLF)\ \left| \begin{array}{l} [\max/\min]\ \widetilde{z}(\widetilde{C}, \widetilde{X}) = \widetilde{C} \cdot \widetilde{X} = \sum_{j=1}^{n} \widetilde{c}_j \widetilde{x}_j \\ \hline \left[\begin{array}{l} \widetilde{A} \cdot \widetilde{X} \overset{\succ}{\underset{\prec}{=}} \widetilde{D} \\ \widetilde{x}_j \succeq \widetilde{0} \quad ,(\forall) j = \overline{1,n} \end{array} \right. \end{array} \right. \tag{15}$$

The linear program (PLA) associated to a fuzzy linear program (PLF) is ***a classic linear program*** (in real numbers) obtained by replacing the triangular fuzzy numbers with their centers of gravity according to the corresponding relation (2).

$$\left.\begin{array}{l} \widetilde{c}_j \longrightarrow <\widetilde{c}_j> \overset{not.}{=} c_j \\ \widetilde{a}_{ij} \longrightarrow <\widetilde{a}_{ij}> \overset{not.}{=} a_{ij} \\ \widetilde{d}_i \longrightarrow <\widetilde{d}_i> \overset{not.}{=} d_i \\ \widetilde{x}_j \longrightarrow <\widetilde{x}_j> \overset{not.}{=} x_j \end{array}\right| \begin{array}{l} ,\forall i = \overline{1,m} \\ ,\forall j = \overline{1,n} \end{array} \Rightarrow$$

$$(PLA)\left|\begin{array}{l} [\max/\min]\ z(C,X) = C\cdot X = \sum_{j=1}^{n} c_j x_j \\ \hline \left[\begin{array}{ll} A\cdot X \overset{\geq}{=} D & \\ \quad\quad\ \ \leq & \\ x_j \geq 0 & ,(\forall) j = \overline{1,n} \end{array}\right. \end{array}\right. \tag{16}$$

Solving a fuzzy linear program (PLF) described by the relations (15) involves following the next algorithmic steps (***Modified Simplex Algorithm***):

PF1. ***All the centers of gravity*** of the input parameters ($\widetilde{c}_j, \widetilde{a}_{ij}, \widetilde{d}_i$) are calculated, and ***the associated linear program (PLA)*** is obtained, which has only real number components.

PF2. The steps of ***the simplex algorithm with the penalty method*** are applied to the classical program (PLA):
- ***Step 1 and Step 2***. The permissible program (PPA) and the first simplex S_0 are established
- ***Step 3*** and ***Step 4*** are repeated k times.

The determining of the pivot positions [(p_1,q_1), ... ,(p_k,q_k)] involves calculating the differences Δ_j and reports $\frac{c_i^B}{s_{ij}}$.

By performing the k pivoting, the simplex tables are obtained: $S_0 \to S_1 \to ... \to S_k$.

PF3. One can return to the initial fuzzy program (PLF) to which a small Simplex table reduced $\widetilde{S}_0$ is associated, where only the columns of variables that entered the base through the pivotals from step PF2 (columns $q_1, ... , q_k$), column **B** (non-numerical).) and the $\mathbf{D^B}$ column are introduced.

The column $\mathbf{C^B}$, the first line and the last two (z_j^B and Δ_j) are no longer needed.

PF4. ***K pivoting movements are performed*** with the positions of the pivots $(p_1,q_1), ... , (p_k,q_k)$ starting from ***the fuzzy simplex*** $\widetilde{S}_0$ and fuzzy simplex tables are obtained: $\widetilde{S}_0 \to \widetilde{S}_1 \to ... \to \widetilde{S}_k$.

At each pivoting the calculations (the divisions on the pivot line and the rectangle rule) are made with triangular fuzzy numbers as defined in the relations (3). In the new simplex fuzzy tables, the calculations in the columns corresponding to the pivots already used are given up.

PF5. The fuzzy components of ***the optimal solution / solutions*** from the last fuzzy Simplex tables ***are read***. In the case of the multiple solutions, the convex combination of the general optimal solution, dependent on v extreme solutions and the real subunit parameters $\lambda_v \in [0,1]$, is calculated.

The optimal value of the objective function (***fuzzy number***) and its center of gravity is calculated. STOP.

An example of solving a fuzzy linear program (PLF) with the modified simplex algorithm

A problem of production planning (hypothetical case)

In a trading company, for the production of the products P_1, P_2, and P_3, the raw materials M_1, M_2 and M_3 are used.

For the manufacture of product P_1 a_{11} units of the raw material M_1, a_{12} units of M_2, and a_{13} units of M_3 are used; for the manufacture of the product P_2 a_{21}, a_{22} and a_{23} units of raw materials are used and for the manufacture of the product P_3 a_{31} is used, a_{32} and a_{33} units of raw materials are used. In stock are d_1 units of raw material M_1, d_2 units of M_2 and d_3 units of M_3 are in stock.

The unit benefits are c_1 u.m. (monetary units) for P_1, c_2 u.m. for P_2 and c_3 u.m. for product P_3. What is the production plan (quantities x_1, x_2 and x_3 of products P_1, P_2 and P_3) in order to obtain the maximum profit?

Given that the general economic stability is very low, all the initial data defining the previous model represent profoundly uncertain information.

Thus, the unit benefit obtained for a P_1 product, which under conditions of total certainty would be 6 u.m, it is estimated by specialists to be between 4 and 10 u.m, as it is mathematically modeled with the triangular fuzzy number $\tilde{c}_1 = (4,5,10)_6$. Similarly, $\tilde{c}_2 = (6,7,8)_7$, $\tilde{a}_{11} = (4,5,6)_5$, etc.

The fuzzy linear program (PLF) corresponding to the presented economic problem has the following form:

$$(PLF)\quad \begin{cases} \underline{[\max]\ \tilde{z} = (4,5,10)_6 \cdot \tilde{x}_1 + (6,7,8)_7 \cdot \tilde{x}_2 + (5,10,11)_9 \cdot \tilde{x}_3} \\ \begin{cases} (4,5,\ 6)_5 \cdot \tilde{x}_1 + (\ 3,\ 4,\ 5)_4 \cdot \tilde{x}_2 + (3,4,\ 9)_5 \cdot \tilde{x}_3 \le (3000,3100,3600)_{3200} \\ (4,5,10)_6 \cdot \tilde{x}_1 + (10,11,16)_{12} \cdot \tilde{x}_2 + (8,9,14)_{10} \cdot \tilde{x}_3 \le (5000,5100,5600)_{5200} \\ (3,4,\ 5)_4 \cdot \tilde{x}_1 + (\ 1,\ 2,\ 3)_2 \cdot \tilde{x}_2 + (2,7,\ 8)_6 \cdot \tilde{x}_3 \le (2200,2300,2800)_{2400} \end{cases} \\ \tilde{x}_{1,2,3} \ge 0 \end{cases}$$

The modified simplex algorithm is applied to solve the fuzzy linear program.

PF1. The first step involves calculating the gravity centers of the triangular fuzzy numbers:

$$< \tilde{c}_1 > = < (4,5,10) > \overset{(2)}{=} \frac{4+2\cdot 5+10}{4} = 6, \ldots, \quad < \tilde{d}_3 > = \frac{2200+2\cdot 2300+2800}{4} = 2400$$

In (PLF) the gravity centers were given as final indices.

After replacing the fuzzy numbers with their gravity centers, the associated classical program is obtained:

$$\text{(PLA)} \quad \left[\begin{array}{l} [\max]\ z = 6\cdot x_1 + 7\cdot x_2 + 9\cdot x_3 \\ \left\{ \begin{array}{l} 5\cdot x_1 + 4\cdot x_2 + 5\cdot x_3 \le 3200 \\ 6\cdot x_1 + 12\cdot x_2 + 10\cdot x_3 \le 5200 \\ 4\cdot x_1 + 2\cdot x_2 + 6\cdot x_3 \le 2400 \end{array} \right. \\ x_{1,2,3} \ge 0 \end{array} \right.$$

PF2. ***The simplex algorithm with the penalty method*** *is applied to the classical program (PLA)*

Thus, after having passed the maximum to the minimum ($w = -z$) and adding the deviation unknowns (which are also penalty variables with M = 900 sufficiently large), we obtain the allowable primal program (PPA) and the corresponding Simplex S_0 table:

$$\text{(PPA)} \quad \left[\begin{array}{l} [\min]\ w = -6\cdot x_1 - 7\cdot x_2 - 9\cdot x_3 + 900\cdot(x_4 + x_5 + x_6) \\ \left\{ \begin{array}{l} 5\cdot x_1 + 4\cdot x_2 + 5\cdot x_3 + x_4 = 3200 \\ 6\cdot x_1 + 12\cdot x_2 + 10\cdot x_3 + x_5 = 5200 \\ 4\cdot x_1 + 2\cdot x_2 + 6\cdot x_3 + x_6 = 2400 \end{array} \right. \\ x_{1,2,\ldots,6} \ge 0 \end{array} \right.$$

Table 2

The Simplex algorithm for the program (PPA)

	B	x_1	x_2	x_3	x_4	x_5	x_6	$\mathbf{D^B}$	$\mathbf{C^B}$	
		–6	–7	–9	900	900	900			
	x_4	5	4	5	1	0	0	3200	900	3200/5=640
$\mathbf{S_0}$	x_5	6	12	10	0	1	0	5200	900	5200/10=520
	x_6	4	2	6	0	0	1	2400	900	2400/6=400
	z_j^B	13500	16200	18900	900	900	900	9720000	0	
	Δ_i	–13506	–16207	–18909	0	0	0			

Table 2 (continued)

		–6	–7	–9	900	900	900			
	x_4	5/3	7/3	0	1	0	–5/6	1200	900	3600/7>500
S_1	x_5	–2/3	26/3	0	0	1	–5/3	1200	900	3600/26<180
	x_3	2/3	1/3	1	0	0	1/6	400	–9	1200
	Z_j^B	894	9897	–9	900	900	–4503/2	2156400	0	
	Δ_j	–900	–9904	0	0	0	6303/2			

		–6	–7	–9	900	900	900			
	x_4	24/13	0	0	1	–7/26	–5/13	11400/13	900	11400/24<500
S_2	x_2	–1/13	1	0	0	3/26	–5/26	1800/13	–7	
	x_3	9/13	0	1	0	–1/26	3/13	4600/13	–9	4600/9>500
	Z_j^B	21526/13	–7	–9	900	–3156/13	–9019/26	10206000/13	0	
	Δ_j	–21604/13	0	0	0	14856/13	32419/26			

		–6	–7	–9	900	900	900		
	x_1	1	0	0	13/24	–7/48	–5/24	475	–6
S_3	x_2	0	1	0	1/24	5/48	–5/24	175	–7
	x_3	0	0	1	–3/8	1/16	3/8	25	–9
	Z_j^B	–6	–7	–9	–1/6	–5/12	–2/3	–4300	0
	Δ_j	0	0	0	5401/6	10805/12	2702/3		

Step 3 and Step 4 (from the classic Simplex algorithm) are repeated three times.

At the third iteration, the Simplex algorithm proceeds to step 5 because all the differences corresponding to the base variables are non-negative (in fact all three are null, 0).

Step 5. The program (PPA) has a unique solution:

$$\boxed{X^{*(1)} = (x_1^*, x_2^*, x_3^*) = (475, 175, 25)}$$

$$\boxed{w^* = -6 \cdot x_1^* - 7 \cdot x_2^* - 9 \cdot x_3^* + 900 \cdot (0 + 0 + 0) = -6 \cdot 475 - 7 \cdot 175 - 9 \cdot 25 = -4300}$$

$$\boxed{z^* = -w^* = -(-4300) = 4300}$$

The positions of the three pivots were: (3, 3), (2, 2) and (1, 1) respectively.

PF3. The reduced fuzzy Simplex program is $\widetilde{S}_0$ from table no. 3, a table containing only columns of variables $\mathbf{x_1}$, $\mathbf{x_2}$ and $\mathbf{x_3}$ and columns $\mathbf{B}$, $\mathbf{D^B}$. All columns and lines that do not participate in fuzzy pivoting operations have been removed:

Table 3

Fuzzy pivot operations in the modified simplex algorithm

$\tilde{S}_0$

B	x_1	x_2	x_3	D^B
x_4	4	3	3	3000
	5	4	4	3100
	6	5	9	3600
	5	4	5	3200
x_5	4	10	8	5000
	5	11	9	5100
	10	16	14	5600
	6	12	10	5200
x_6	3	1	2	2200
	4	2	7	2300
	5	3	8	2800
	4	2	6	2400

$\tilde{S}_1$

B	x_1	x_2	x_3	D^B
x_4	–0.847	0.097		–266.667
	2.181	2.778		1529.167
	3.153	3.681		2008.333
	1.667	2.333		1200
x_5	–3.361	2.528		–683.333
	–0.556	9.722		1633.333
	1.806	12.694		2216.667
	–0.667	8.667		1200
x_3	0.361	0.139		250
	0.722	0.361		425
	0.861	0.472		500
	0.667	0.333		400

$\tilde{S}_2$

B	x_1	x_2	x_3	D^B
x_4	0.059			–127.885
	2.139			1004.604
	3.048			1626.368
	1.846			876.923
x_2	–0.25			–19.231
	–0.075			171.893
	0.093			229.29
	–0.077			138.462
x_3	0.225			105.609
	0.768			388.696
	1.008			532.384
	0.692			353.846

All numeric cells contain 4 components: the first three are the components of the triangular fuzzy number and the fourth (below the dotted line) is its center of gravity.

$\tilde{S}_3$

B	x_1	x_2	x_3	D^B
x_1				–27.008 547.237 832.534
				475
x_2				–13.256 203.845 305.566
				175
x_3				–242.506 28.747 285.012
				25

PF4. The calculations of the three pivoting movements containing operations with triangular fuzzy numbers are as follows:

The first pivot movement that goes from the table (simplex fuzzy) $\tilde{S}_0$ to the table $\tilde{S}_1$ has the fuzzy number $\tilde{a}_{33}^{(0)} = (2,7,8)_6$ as pivot. The column of the pivot is no longer calculated.

The elements on the pivot line (line 3) are divided by the pivot:

$$\tilde{s}_{31}^{(1)} = \frac{\tilde{s}_{31}^{(0)}}{\tilde{s}_{33}^{(0)}} = \frac{(3,4,5)_4}{(2,7,8)_6} = \frac{6\cdot(3,4,5)+4\cdot(2,7,8)}{2\cdot 6^2} = \frac{(18+8,24+28,30+32)}{72} = \left(\frac{13}{36},\frac{26}{36},\frac{31}{36}\right)_{\frac{2}{3}}$$

$$\tilde{s}_{31}^{(1)} \approx (0.361,0.722,0.861)_{0.667}$$

The center of gravity, given as an index, is:

$$< \tilde{s}_{31}^{(1)} > = \frac{13+2\cdot 26+31}{4\cdot 36} = \frac{96}{4\cdot 36} = \frac{2}{3} \approx 0.667\cdot$$

The other two fuzzy numbers on the pivot line are similarly calculated:

$$\tilde{s}_{32}^{(1)} = \frac{\tilde{s}_{32}^{(0)}}{\tilde{s}_{33}^{(0)}} = \frac{(1,2,3)_2}{(2,7,8)_6} = \ldots \quad \text{respectiv} \quad \tilde{d}_3^{(1)} = \frac{\tilde{d}_3^{(0)}}{\tilde{s}_{33}^{(0)}} = \frac{(2200,2300,2800)_{2400}}{(2,7,8)_6} = \ldots$$

The other six fuzzy numbers that make up the simplex $\tilde{S}_1$ are calculated according to the rectangle rule:

$$\tilde{s}_{11}^{(1)} = \frac{\tilde{s}_{11}^{(0)}\cdot\tilde{s}_{33}^{(0)} - \tilde{s}_{31}^{(0)}\cdot\tilde{s}_{13}^{(0)}}{\tilde{s}_{33}^{(0)}} = \frac{(4,5,6)_5\cdot(2,7,8)_6 - (3,4,5)_4\cdot(3,4,9)_5}{(2,7,8)_6}$$

$$(4,5,6)_5\cdot(2,7,8)_6 = \frac{6\cdot(4,5,6)+5\cdot(2,7,8)}{2} = \frac{(24+10,30+35,36+40)}{2} = \frac{(34,65,76)_{60}}{2}$$

$$(3,4,5)_4 \cdot (3,4,9)_5 = \frac{5\cdot(3,4,5)+4\cdot(3,4,9)}{2} = \frac{(27,36,61)_{40}}{2}$$

$$\frac{(34,65,76)_{60}}{2} - \frac{(27,36,61)_{40}}{2} = \frac{(34-61,65-36,76-27)}{2} = \frac{(-27,29,49)_{20}}{2}$$

$$\tilde{s}_{11}^{(1)} = \frac{\frac{(-27,29,49)_{20}}{2}}{(2,7,8)_6} = \frac{6\cdot(-27,29,49)+20\cdot(2,7,8)}{2\cdot 2\cdot 6^2} = \frac{(-162+40,174+140,294+160)}{4\cdot 36}$$

$$\tilde{s}_{11}^{(1)} = \frac{(-122,314,454)}{144} = \frac{(-61,157,227)_{120}}{72} \approx (-0.847,2.181,3.153)_{1.667}$$

The other five fuzzy numbers in the simplex are calculated similarly (according to the rectangle rule):

$$\tilde{s}_{12}^{(1)} = \frac{\tilde{s}_{12}^{(0)}\cdot\tilde{s}_{33}^{(0)} - \tilde{s}_{32}^{(0)}\cdot\tilde{s}_{13}^{(0)}}{\tilde{s}_{33}^{(0)}} = \ldots, \quad \tilde{s}_{21}^{(1)} = \frac{\tilde{s}_{21}^{(0)}\cdot\tilde{s}_{33}^{(0)} - \tilde{s}_{31}^{(0)}\cdot\tilde{s}_{23}^{(0)}}{\tilde{s}_{33}^{(0)}} = \ldots,$$

$$\tilde{s}_{22}^{(1)} = \frac{\tilde{s}_{22}^{(0)}\cdot\tilde{s}_{33}^{(0)} - \tilde{s}_{32}^{(0)}\cdot\tilde{s}_{23}^{(0)}}{\tilde{s}_{33}^{(0)}} = \ldots$$

$$\tilde{d}_1^{(1)} = \frac{\tilde{d}_1^{(0)}\cdot\tilde{s}_{33}^{(0)} - \tilde{s}_{13}^{(0)}\cdot\tilde{d}_3^{(0)}}{\tilde{s}_{33}^{(0)}} = \ldots, \qquad \tilde{d}_2^{(1)} = \frac{\tilde{d}_2^{(0)}\cdot\tilde{s}_{33}^{(0)} - \tilde{s}_{23}^{(0)}\cdot\tilde{d}_3^{(0)}}{\tilde{s}_{33}^{(0)}} = \ldots$$

The first iteration of the Fuzzy simplex algorithm is fully achieved: $\tilde{S}_0 \longrightarrow \tilde{S}_1$.

The calculations for the other two iterations are similar $\tilde{S}_1 \longrightarrow \tilde{S}_2 \longrightarrow \tilde{S}_3$.

PF5. The last Fuzzy simplex table $\tilde{S}_3$ reads the following solutions:

$$\boxed{\tilde{x}_1^* = (-27.008, 547.237, 832.534)_{475}} \qquad \boxed{\tilde{x}_2^* = (-13.256, 203.845, 305.566)_{175}}$$

$$\boxed{\tilde{x}_3^* = (-242.507, 28.747, 285.012)_{25}}$$

The optimal value and its center of gravity are:

$$< \tilde{w}^* > = < -(4,5,10)_6 \cdot \tilde{x}_1^* - (6,7,8)_7 \cdot \tilde{x}_2^* - (5,10,11)_9 \cdot \tilde{x}_3^* >$$

$< \tilde{w}^* > = -6\cdot 475 - 7\cdot 175 - 9\cdot 25 = -4300$, $\boxed{< \tilde{z}^* > = - < \tilde{w}^* > = -(-4300) = 4300}$.

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IONEL-CIPRIAN ALECU[1]

METHODOLOGICAL ASPECTS REGARDING THE USE OF TRIANGULAR FUZZY NUMBERS WITH ASSOCIATED VARIABLE INDICATORS IN DECISION MAKING

Abstract: *The efficiency of the decision making process and the proper management of the situations of uncertainty require the intensification of the interdisciplinary theoretical approaches and the adaptation of methods from related fields. Uncertainty is no longer treated only as a factor that generates difficulties, but becomes an instrument in the management strategies, an opportunity for development.*

At the same time, the advances in the fuzzy theory allow the outline of new horizons in approaching the theoretical concepts in management, the development of existing methods and the outline of new lines of theoretical analysis. The use of fuzzy numbers with associated indicators is becoming increasingly important in developing decision making methods. In this context, the present article proposes the development of triangular fuzzy numbers with variable associated indicators and based upon specific elementary operations. Thus, a new theoretical direction for approaching the decision making processes and specific instruments is proposed, which is much closer to the practical mode, depending upon an index of uncertainty adsorption and management.

Key words: *fuzzy numbers, triangular fuzzy numbers with associated indicators, decision making.*

JEL: *D81, M21*

Introduction

Gradually, the uncertainty is no longer dealt with mainly through the concept of probability, a theoretical construct that has proven its advantages in analyzing past experiences and making forecasts, but also its limitations in capturing possible courses of action. More and more theoretical and applicative challenges are related to approaching decisions in conditions of uncertainty degree II or III, as these became increasingly important in the current economic and social context.

In order to absorb the persistent uncertainty (degree III), several management tools have been crystallized by which the entrepreneurs can manifest a logically structured attitude in extreme situations. In practice, one can resort to several categories of methods and techniques for managing this phenomenon: technocratic,

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political, structural or cultural, etc. Their effect upon the way the decision making process is structured is difficult to overcome by classical instruments, by crisp (real) numbers.

Therefore, the process of making decision under conditions of uncertainty required the development of new ways of its reduction or adsorption. A very important tool is the approach using fuzzy numbers.

In order to make operations with fuzzy numbers much easier, the use of associated indicators has been proposed: the center of gravity, the middle of the support and the core, the sign, the global indicator, etc.

To capture the potential of endogenous uncertainty, we propose (where the situation requires it, where the internal entropy of the system cannot be accurately or probabilistically determined) the use of fuzzy numbers with a variable center of gravity.

The variable character is captured by an associated coefficient - α which can take strictly positive and subunit values, between 0 and 1.

As its values experience a tendency toward 0, the fuzzy numbers capture a state of total ambiguity and pessimism internal to the system, which influences the evaluations made. On the contrary when the values of α experience a tendency towards 1, an optimistic state is expressed, where the mechanisms of absorption of uncertainty tend to cover a large part of the difficulties.

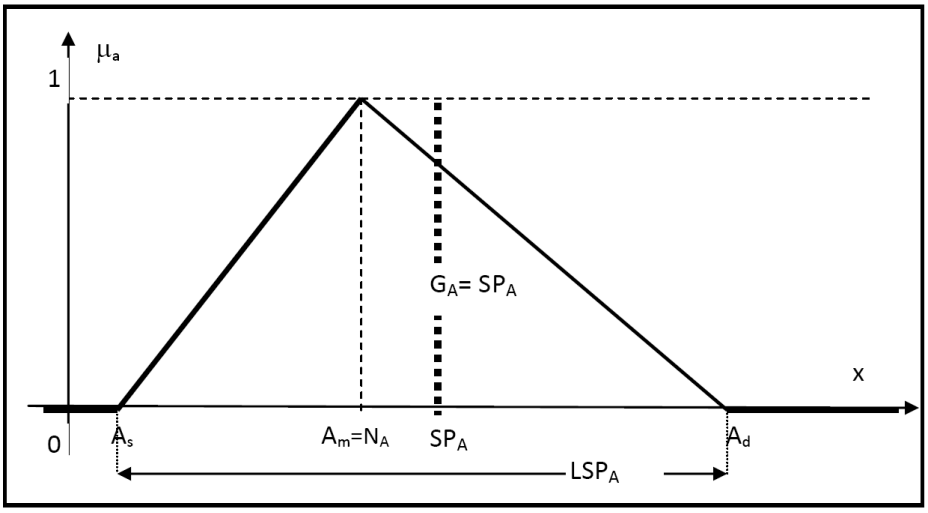
Triangular fuzzy numbers and associated indicators

A triangular fuzzy number ($\mathbf{NFT_r}$) can be represented in different forms, starting from the definition given by Zadeh and up to the theoretical and practical developments utilized in the last decades, (of which Gherasim 2005, Tofan 2007, Maturo 2009, Jachobsen 2004, Wang 2009) are useful to our demonstration.

In view of the objective pursued, a triangular fuzzy number may be represented simply by an ordered triplet of the form $A = (A_s, A_m, A_d) \in \mathbf{NFT_r}$ having the membership function $\boldsymbol{\mu_A}: \boldsymbol{R} \rightarrow [\mathbf{0}, \mathbf{1}]$ defined as follows:

$$\boldsymbol{\mu_A(x)} = \begin{cases} \frac{\boldsymbol{x - A_s}}{\boldsymbol{A_m - A_s}} & , \boldsymbol{A_s \leq x \leq A_m} \\ \mathbf{1} & , \boldsymbol{x = A_m} \\ \frac{\boldsymbol{A_d - x}}{\boldsymbol{A_d - A_m}} & , \boldsymbol{A_m \leq x \leq A_d} \\ \mathbf{0} & , \boldsymbol{x \notin [A_s, A_d]} \end{cases} \quad (1)$$

Graphically, a triangular fuzzy number is represented according to Graph 1, where one can see the simple and synthetic associated indicators:



Graph 1. A triangular fuzzy number

In order to be able to work with these triangular fuzzy numbers, many simple or synthetic indicators have been defined. Among *the simple indicators* we recall:

The core (which coincides with a_m***)***	$N(A) = \{A_m\}$
The support	$Sp(A) = (A_s, A_d)$
The length of the support	$LSP_A = A_d - A_s \geq 0$
The middle of the core	$N_A = A_m$
The middle of the support	$SP_A = \frac{A_s + A_d}{2}$
Area to the left	$S_A^L = \int_{A_s}^{N_A} \mu_A(x)\mathrm{dx}$
Area to the right	$S_A^R = \int_{N_A}^{A_d} \mu_A(x)\mathrm{dx}$
Total area	$S_A = S_A^L + S_A^R$
The sign	$\delta_A = \begin{cases} sign(N_A) \ , N_A \neq 0 \\ sign(A_m) \ , A_m = 0 \end{cases}$

The synthetic indicators associated with a triangular fuzzy number

The synthetic indicators are real numbers associated with fuzzy numbers whose value belongs to the support, which are determined by the shape and size of the fuzzy numbers. The purpose of developing these sizes was to build a real synthetic image representative of a triangular fuzzy number, thus helping to ease the specific calculations.

Most times they have been developed in the form of central tendency indicators, or weight centers depending upon the simple indicators that define the

triangular fuzzy number (for example, the triplet which defines a triangular fuzzy number). Among the most common and defining methods for synthetic indicators (G_A), there are as follows:

- ***the middle of the core*** $G_A = A_m$
- ***the middle of the support*** $G_A = SP_A = \frac{A_s + A_d}{2}$
- ***the expected value (average) of the nuance / estimate*** $G_A = \frac{A_s + A_m + A_d}{3}$
- ***the center of gravity (Gherasim 2004))*** $G_A = \frac{A_s + 2 * A_m + A_d}{2}$
- ***the center of gravity*** $G_A = N_A + \frac{S_{A-}^R S_A^L}{2}$
- ***the center of gravity (Tofan, 2011) (***$\mathrm{k} > 1$) $G_A = \frac{k * A_s + 2(2-k)A_m + k * A_d}{2}$

From the viewpoint of the operationality of the theoretical and practical framework, a special approach is the development proposed by Gherasim (2004), where through the operations for the advanced fuzzy numbers the space is assumed and based upon 2 synthetic indicators: the center of gravity and the ordering indicator.

By analyzing how to define the center of gravity we note that starting from the general formula: $G_A = \frac{N_A + SP_A}{2}$ we arrive at a unitary and integrated approach for fuzzy rectangular, triangular, and trapezoidal numbers, where in particular we get the following representations:

- for rectangular fuzzy numbers (NFD), $(\forall) A = (A_m, A_M) \in \mathrm{NFD}$

$$G_A = \ < A > \ = \frac{A_m + A_M}{2}$$

- for triangular fuzzy numbers (NFTr) $(\forall)\mathrm{A} = (\mathrm{A_s}, \mathrm{A_m}, \mathrm{A_d}) \in \mathrm{NFTr}$

$$G_A = \ < A > \ = \frac{A_s + 2 \cdot A_m + A_d}{4}$$

- for trapezoidal fuzzy numbers (NFTp) $(\forall)\mathrm{A} = (\mathrm{A_s}, \mathrm{A_m}, \mathrm{A_M}, \mathrm{A_d}) \in \mathrm{NFTp}$

$$G_A = \ < A > \ = \frac{A_s + A_m + A_M + A_d}{4}$$

To allow the ordering of fuzzy numbers, in the same line, the global ordering indicator $O_A \in R$ associated with a triangular fuzzy number was constructed:

$$O_A = (G_A, N_A, \delta_A * LSP_A)$$

According to this indicator, two fuzzy numbers are ordered according to the size of the gravity centers, then by the middle of the cors, and then by the length of the support multiplied by the sign.

Center of variable gravity G_α associated to a triangular fuzzy number

The methods of management of the uncertainty of degree III have undergone constant developments through qualitative techniques of political, economic and social nature, aiming at: the artificial absorption of uncertainty; the artificial creation of uncertainty; the transfer of uncertainty; the obstruction or "strategic failure"; the reaching of the critical mass, etc.

The use of synthetic indicators associated with the fixed fuzzy numbers in the decision making processes related to the principle of mathematical expectation of the estimated values becomes insufficient to cover the broad spectrum of economic and social decision making situations.

The proposal is to develop a variable synthetic indicator that expresses the nature of the uncertainty absorption strategy estimated in the nuanced form (by the fuzzy number).

When discussing triangular fuzzy numbers, the variable associated indicator (see Alecu) was defined:

$$G_{A(\alpha)} = a_m + \alpha \cdot (a_M - a_m) = a_m \cdot (1-\alpha) + a_M \cdot \alpha,$$

Where: $\alpha \in [0;1]$ is on indicator of adosorption / management of uncertainty.

$G_{A(\alpha)}$- represents the center of variable gravity associated with the rectangular fuzzy number.

A classic synthetic center of gravity formula is as defined below:

$$G_A = A_N + \frac{S_{A-}^R S_A^L}{2} \quad sau \quad G_A = A_N + \frac{1}{2}(S_A^R) - \frac{1}{2}(S_A^L)$$

By adding the coefficient of absorption of uncertainty $\alpha = \frac{1}{2} \in [0,1]$ one will easily obtain:

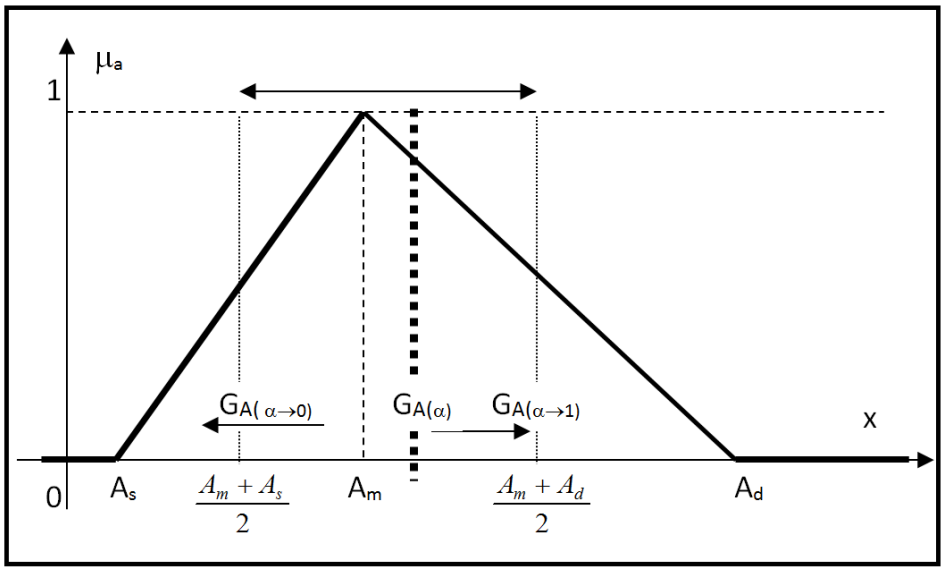
$$G_{A(\propto=\frac{1}{2})} = N_A + \propto (S_A^R) - (1-\propto)(S_A^L)$$

Starting from the general definition of the variable center of gravity associated with a general fuzzy number (Alecu, *Idei și Valori*, 2012), we propose as a synthetic way of defining the variable associated center of gravity for a triangular fuzzy number:

$$\boldsymbol{G_{A(\alpha)} = N_A + (\alpha - 1) \cdot S_A^L + \alpha \cdot S_A^R}$$

where: $\boldsymbol{\alpha \in [0, 1]}$ - is an indicator of adsorption / uncertainty management.

Graphically, a triangular fuzzy number with the associated variable center of gravity is represented in the following graph, where one can notice how the uncertainty and its management can be rendered by the associated indicator variability.



Graph 2. Triangular fuzzy number with variable associated center of gravity

By analyzing how the associated center of gravity can evolve one can identify three possible situations:

– a pessimistic uncertainty management attitude where the center of gravity $G_{\alpha\to 0}$ moves to the left on the segment $\left[\frac{A_s+A}{2}, A_m\right]$

– an optimistic uncertainty management attitude in which the center of gravity $G_{\alpha\to 1}$ moves to the right on the wing $\left[A_m, \frac{A_m+A_d}{2}\right]$.

– an equal attitude, which may be indifferent, an unresponsive attitude, or it can be a complex state of management focused upon the values most desired to be achieved. If one cannot undertake policies or strategies to absorb uncertainty, one is in a state of ambiguity in which the variable center will be the center of gravity.

By replacing simple indicators in the variable center of gravity formula for a triangular fuzzy number one will obtain:

$$G_\alpha = A_m + (\alpha - 1) \cdot \frac{A_m - A_s}{2} + \alpha \cdot \frac{A_d - A_m}{2} \rightarrow$$

$$G_\alpha = \frac{A_m + (1-\alpha) \cdot A_s + \alpha \cdot A_d}{2}$$

This can be transformed into a (very wide acceptance) useful form of praxis and uncertainty management methodology:

$$G_\alpha = \frac{(1-\alpha)\cdot(A_s + A_m) + \alpha\cdot(A_d + A_m)}{2}$$

Or, to put it more simply, in a specific acceptance of the complex conceptual framework of uncertainty management, applicable to any fuzzy number:

$$\boldsymbol{G_\alpha = (1-\alpha)\cdot(Nuancing\ to\ the\ left) + \alpha\cdot(Nuancing\ to\ the\ right)}$$

From the view point of the conceptual framework unit, we stress the fact that the customized use of the term of nuancing to the left / right instead of the term of variation to the left / right is not exclusive, but only equal, and it means the same thing. The concept of nuance integrates both the qualitative and quantitative variables. Or one can define the center of gravity for quantitative representations:

$$\boldsymbol{G_\alpha = (1-\alpha)\cdot(Variation\ to\ the\ left) + \alpha\cdot(Variation\ to\ the\ right)}$$

This simplified expression of the image of a fuzzy number will almost inevitably lead to new forms and developments of the synthetic indicators associated with the fuzzy numbers by which the management can carry out an approach to managing the absolute uncertainty as logically structured as possible.

If one analyzes the variation of the uncertainty adsorption coefficient, the situations identified for the center of variable weight are as follows:

a. For $\alpha \to 0$ (a pessimistic attitude) one will have:

$$G_{(\alpha\to 0)} \to [N_A - S_A^L] + 0\cdot S_A^R = A_N - S_A^L = A_m - \frac{A_m - A_s}{2} = \frac{A_s + A_m}{2}$$

b. For $\alpha \to 1$ (an optimistic attitude) one will have:

$$G_{(\alpha\to 1)} \to [N_A - 0\cdot S_A^L] + S_A^R = N_A + S_A^R = A_m + \frac{A_d - A_m}{2} = \frac{A_m + A_d}{2}$$

c. For a $\alpha \to \frac{1}{2}$ the center of variable gravity coincides with the (fixed) center of gravity:

$$G\_((\alpha \to 1/2)\ ) \to N\_A + (1/2 - 1)\cdot S\_A\hat{}L + 1/2\cdot S\_A\hat{}R$$
$$= N\_A + 1/2\cdot S\_A\hat{}L + 1/2\cdot S\_A\hat{}R$$
$$= N\_A + (S\_A\hat{}R - S\_A\hat{}L)/2$$

$$G_{\left(\alpha\to\frac{1}{2}\right)} \to \frac{A_s + 2\cdot A_m + A_d}{4}.$$

The ***sign of the variable center of gravity*** $\delta(G_\alpha$, associated with a triangular fuzzy number is defined as:

$$\delta(G_\alpha) = \begin{cases} sign\left((1-\alpha)\cdot\dfrac{A_s + A_m}{2} + \alpha\cdot\dfrac{A_d + A_m}{2}\right) & , G_\alpha \neq 0 \\ sign(A_m) & , G_\alpha = 0 \end{cases}$$

Elementary operations with triangular fuzzy numbers using associated variable indicators

We will define the main operations such as adding, subtracting, multiplying and dividing by number intervals to which different variable centers of gravity have been associated.

A simplified way in defining a triangular fuzzy number with center of variable gravity A_α of is a fuzzy number $A_\alpha=(A_s, A_m, A_d)_\alpha \in NFT_r$ defined as a fuzzy set on R, having the membership function $\mu_A:R\rightarrow[0,1]$, in the following form:

$$\mu_a(x) = \begin{cases} \dfrac{x - a_s}{a_m - a_s} & , a_s \le x \le a_m \\ 1 & , x = a_m \\ \dfrac{a_d - x}{a_d - a_m} & , a_m \le x \le a_d \\ 0 & , x \notin [a_s,\ a_d] \end{cases} \quad \text{where } A_s < A_m < A_d,$$

to which an indicator of preference $\alpha \in [0.1]$ was associated as an expression of the way of absorbing the endogenous uncertainty manifested in the specific decision making process.

The ***center of variable gravity*** associated with a fuzzy number G is the real size $G_\alpha \in \mathbf{R}$, which is obtained by the following relation:

$$\boldsymbol{G_{A(\alpha)} = N_A + (\alpha - 1)\cdot S_A^L + \alpha\cdot S_A^R}$$

The value of α does not influence the membership function of the fuzzy number, but only takes into account the affinity / inclination of the decision making subject to the uncertainty, the anxiety manifested within a specific decision making process assumed.

Let there be triangular fuzzy numbers with variable centers of gravity:

$A_\alpha = (A_s; A_m; A_d)_\alpha$, $B_\beta = (B_s; B_m; B_d)_\beta$ si $C_\gamma = (C_s; C_m; C_d)_\gamma \in$ NFT_r, where $\alpha, \beta, \gamma \in [0,1]$ the two assumed levels of absorption of uncertainty, the specific gravity centers with respectively $G_{A(\alpha)}$, $G_{B(\beta)}$ and $G_{C(\gamma)}$

We propose the following basic operations:

• ***Definition: The addition*** of two triangular fuzzy numbers $A_\alpha, B_\beta \in NFT_r$ with associated gravity centers according to $\alpha, \beta \in [0,1]$ is the law of composition $\oplus: NFT_r \times NFT_r \to NFT_r$, having the following form:

$$C_\gamma = A_\alpha \oplus B_\beta \stackrel{def}{=} \begin{cases} (A_s + B_s; A_m + B_m; A_d + B_d)_\gamma \\ \gamma = (\alpha(A_s + B_s) + \beta(A_d + B_d))/(A_s + B_s + A_d + B_d) \end{cases}.$$

where: $\gamma \in [0,1]$ is the absorption coefficient of the uncertainty generated by addition.

One can notice that the assembly operation is a law of stable, associative and commutative composition.

• ***Definition: The multiplication of a triangular fuzzy number*** $A_\alpha \in NFT_r$ with the associated center of gravity variable $\alpha \in NFT_r$ with a scalar $t \in \mathbf{R}$ is a triangular fuzzy number $C_\gamma = (C_s; C_m; C_d)_\gamma \in NFT_r$ of the form:

$$C_\gamma = t * A_\alpha \stackrel{def}{=} \begin{cases} (t * A_s; t * A_m; t * A_d)_\gamma, & \gamma = \alpha, t \geq 0 \\ (t * A_s; t * A_m; t * A_d)_\gamma, & \gamma = 1 - \alpha, t < 0 \end{cases}$$

• ***Definition: The subtraction of two triangular fuzzy numbers*** $A_\alpha, B_\beta \in NFT_r$ with associated variable gravity centers according to $\alpha, \beta \in [0,1]$ is the law of composition $(-): NFT_r \times NFT_r \to NFT_r$, with the following form:

$$C_\gamma = A_\alpha (-) B_\beta \stackrel{def}{=}$$
$$\begin{cases} A_\alpha (-) B_\beta \stackrel{def}{=} (A_s - B_s; A_m - B_m; A_d - B_d)_\gamma \\ \gamma \stackrel{def}{=} (\alpha(A_s + B_s) + (1 - \beta)(A_d + B_d))/(A_s + B_s + A_d + B_d) \end{cases}.$$

We notice that the multiplication operation is a law of stable composition and the result was a triangular fuzzy number.

• ***Definition: The multiplication of two triangular fuzzy numbers*** $A_\alpha, B_\beta \in NFT_r$ with associated centers of gravity depending upon $\alpha, \beta \in [0,1]$ is the law of composition $\otimes: NFT_r \times NFT_r \to NFT_r$, having the following form:

$$C_\gamma = A_\alpha \otimes B_\beta \stackrel{def}{=} \begin{cases} \frac{A_\alpha * G_{B(\beta)} + B_\beta * G_{A(\alpha)})}{2} \\ \gamma = (\alpha * \beta)/(\frac{\alpha + \beta}{2}) \end{cases},$$

$$= \begin{cases} (\frac{A_s * G_{B(\beta)} + B_s * G_{A(\alpha)})}{2}; \\ \frac{A_m * G_{B(\beta)} + B_m * G_{A(\alpha)})}{2}; \frac{A_d * G_{B(\beta)} + B_d * G_{A(\alpha)})}{2}) \\ \gamma = (\alpha * \beta)/(\frac{\alpha + \beta}{2}) \end{cases}_\gamma$$

• ***Definition: The division of two triangular fuzzy numbers*** $A_\alpha, B_\beta \in NFT_r$ with associated variable centers of gravity according to $\alpha, \beta \in [0,1]$ is the law of composition $(/): NFT_r \times NFT_r \to NFT_r$ with the following form:

$$C_\gamma = A_\alpha(/)B_\beta \stackrel{def}{=} \begin{cases} \frac{A_\alpha * G_{B(\beta)} + B_\beta * G_{A(\alpha)}}{2*(G_{B(\beta)})^2} \\ \gamma = \frac{\alpha*(1-\beta}{\frac{\alpha+(1-\beta)}{2}}) \end{cases} ..$$

• Ordering ***criteria***

The ordering of the triangular fuzzy numbers with variable centers of gravity is done upon the basis of several successive criteria:

– ***the gravity center criterion*** $:\begin{cases} G_{A(\alpha)} > G_{B(\beta)} \to A_\alpha > B_\beta \\ G_{A(\alpha)} < G_{B(\beta)} \to A_\alpha < B_\beta \end{cases}$

If the centers of gravity do not achieve a clear separation of the two triangular fuzzy numbers, one should move on to the following criterion:

– ***the core means criterion*** $:\begin{cases} N_A > N_B \to A_\alpha > B_\beta \\ N_A < N_B \to A_\alpha < B_\beta \end{cases}$

If the centers of gravity and the means of the cores of two fuzzy triangular numbers are equal then the division will be made according to:

– ***the criterion of the sign lengths of the supports (cores):***

$$\begin{cases} sign(A) * LSP_A > sign(B) * LSP_B \to A_\alpha > B_\beta \\ sign(A) * LSP_A < sign(B) * LSP_B \to A_\alpha > B_\beta \end{cases}$$

Conclusions

From the epistemological point of view we can say that the fuzzy numbers play a special role in the management of decisions through the contributions made in the study of the socio-economic phenomena, the laws governing thereof, the uncertainty and risks of their production, in analyzing the performances of the implemented strategies and programs, etc.

In the case of our paper, the focus was to develop a new model for making decisions in conditions of persistent uncertainty (degree III) starting from the formal or informal methods of managing uncertainty, by using triangular fuzzy numbers with associated variable indicators.

As one can notice, from a practical viewpoint, the triangular fuzzy numbers with associated variable indicators respond much better to the need for a logical argumentation for the selection of a course of action in conditions of a degree III of uncertainty; they allow the opening of new perspectives in modeling information

on economic and social phenomena with great ease and they thus justify the growing interest for the theoretical and practical aspects of these specific instruments.

Among the main points of view underlying the importance of developing a variable gravity center associated to fuzzy numbers one can list: estimated information is utilized for uncertain statistically insufficient events (possibilities, not probable events); it captures certain environmental trends (growth, recession) etc.; it captures the potential informational entropies generated by internal evaluation errors of the system; it contributes to avoiding the excessive use of mathematical expectation; it captures the risk affinity or aversion of the person performing the assessment or appraisal; it captures the subjective mechanisms of absorption of uncertainty utilized in the management of the organization, and so on.

The variable gravity center associated of fuzzy numbers becomes an important construct for absorbing uncertainty in management techniques. Through a guided manipulation thereof, one can define a threshold in assuming one direction of action at the expense of another based upon long-term strategies a company is constantly investing in. This opens up new horizons for the theoretical approach of using these mathematical constructs in the management of uncertainty.

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COMPETITIVENESS OF THE ENTERPRISE: THE ESSENCE AND METHODS OF EVALUATION

Abstract. *This article is devoted to the analysis of existing scientific approaches to the study of the concept of competitiveness. The features and problems of assessing the competitiveness of the enterprise are indicated. An analysis of the theoretical aspects of the competitiveness of enterprises was carried out; the existing approaches to assessing its competitiveness were investigated. The conceptual, systemic, integrated and functional approaches to assessing the competitiveness of an enterprise are considered. Based on a systematic approach, types of competitiveness are identified. The tasks of forming and developing a strategy to increase competitiveness are identified. The factors of creating a strategy to increase competitiveness and the main provisions of competitiveness as a factor of strategic development are identified. Actual problems related to competitiveness were described, various sets of indicators for assessing the level of enterprise competitiveness are described, a special system of methods for assessing competitiveness is considered. Along with theoretical studies of the essence of competition and competitiveness in the economic literature, the problem of a practical assessment of competitiveness is being discussed. The study of competitors and the conditions of competition is required by the enterprise primarily in order to determine what its advantages and disadvantages are compared to competitors, and to draw conclusions for developing its own successful competitive strategy and maintaining competitive advantages. According to the results of the study, it was found that using an integrated approach to assessing the level of enterprise competitiveness allows you to quickly and more objectively get a picture of the situation of the enterprise. In assessing the relevance of the competitiveness problem at the current stage of management, the authors emphasize the need for widespread use of competitiveness tools, as well as the choice of competitive strategies of an enterprise, while the most important task of managing an enterprise's competitiveness in a market is to ensure that it is possible to achieve the necessary competitive advantages by various means and methods.*

Key words: *analysis, competition, competitiveness, enterprise, methodology, strategy*.

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1. Introduction

At the present stage of formation and development of a market economy, the issue of ensuring a high level of competitiveness of enterprises, which is one of the conditions for maintaining the position of enterprises in the domestic and international markets, becomes especially important. The success of an enterprise in a competitive environment is determined by the constant monitoring of market positions, the study of strengths and weaknesses of both its own business activities and competitors, and its ability to adapt to changes in the market situation.

Competitiveness is one of the main economic categories. As a rule, this concept is associated with the advantages of an object, the success of its functioning, and the ability to develop. The research problem is determined, firstly, by the fact that in order to achieve success it is necessary to manage competitiveness. Everyone strives to be competitive, but in reality, enterprises differ significantly in their ability to get ahead of competitors. Secondly, to create a competitiveness management în a market economy, when the possibility of further development to the enterprise directly depend s on the implementation of effective economic activity system, a theoretical justification of the content of the concept of "competitiveness" is necessary, as well as the structure and causal relationships that determine competitiveness.

Today, the most important factors in the competitiveness of enterprises are the high quality of production and management, that is, the ability of an enterprise to design, manufacture, market and maintain competitive products that exceed those of competitors and consumers in preferred demand, quickly update the range of products, search for new market niches, systematic improving the quality of the enterprise throughout the entire production process. Of particular relevance are the problems of developing organizational and economic mechanisms, models and methods for analyzing and assessing the level of competitiveness of enterprises.

Thus, in a market economy, competition is the engine of economic development, which aims to increase competitiveness and create new jobs. In the market each manufacturer is interested in gaining a position as advantageous as possible with respect to the other participants. As a result, a healthy competitive environment is a factor of progress, efficiency and well-being. In order to ensure a stable competitive environment, the regulatory framework prohibits the undertaking of unfair competition activities, abuse of dominant power and the conclusion of agreements between companies which have the effect of diminishing the rivalry between companies.

2. The economic content of the concept of enterprise competitiveness

At the present stage of development of market relations, competition and competition are the main content of the functioning of an economic system based on market mechanisms, key categories in the general scheme of categories of market economy. Thanks to competition in the market, the following is ensured:

the best coordination of manufacturers' production plans with the needs of potential buyers; the most efficient spending of different types of resources; distribution of income (profit) between producers in accordance with their final economic and financial performance. The competition issue has aroused interest since ancient times. Evidence in this regard serves the Code of Justinian, one of the titles whose title is "De monopoliis, et conven tun egotia to rumillicto, velartificioergo laborumnec non balneatorum prohibitis, etpaction ibusillicitis" [Codex Iustinianus, 1892]. However, in the Roman period studies in this sens eare not found. Theoretical provisions of this economic category appeared only in the middle of the XVIIIth century. The main merit in this belongs to the representatives of classical political economy A. Smith, D. Ricardo. According to A. Smith, competition is a set of interconnected attempts by sellers to establish control in the market in the long term. He also identified factors that determine the dominance of states in international trade (land, capital, natural resources and labor).

Therefore, competition is a process of reaction to a new force and a way to achieve a new balance, the essence of which is the competition of competitors for relative advantages Theoretical provisions of this economic category appeared only in the middle of the XVIIIth century. The main merit in this belongs to the representatives of classical political economy A. Smith, D. Ricardo. According to A. Smith, competition is a set of interconnected attempts by sellers to establish control in the market in the long term. He also identified factors that determine the dominance of states in international trade (land, capital, natural resources and labor). Therefore, competition is a process of reaction to a new force and a way to achieve a new balance, the essence of which is the competition of competitors for relative advantages [Smith A., 1992: 476].

This approach was logically developed in the works of D. Ricardo, who introduced the concept of comparative advantages of states in the production of certain groups of goods. Due to the appearance of these approaches, competitiveness for many years has become associated with the ability of business entities and countries to create goods and services with lower cost than others. The classical economists opposed the government's involvement in market affairs, but they were of the opinion that the competitive process would produce efficient results, given the limited regulation of competition [Ricardo D., 1993].

The content of the concept of competition at different stages of development was defined differently, being influenced more or less by economic theories. The interest of the researchers regarding the competition phenomenon dates from the end of the XIXth century with the beginning XXth century with the adoption in the USA of the first acts regulating this subject: Sherman Act, adopted July 2, 1890, Clayton Act, adopted on October 15, 1914 and the Federal Trade Commission Act, adopted in 1914.The theory of competition received significant development thanks to the works of A. Marshall, J. Keynes, J. Schumpeter, P. Sraffa, M. Porter, and others [Marshall A., 1920; Schumpeter J., 1994; Porter M.E., 1998].

Since the twentieth century, influenced by the contradictory processes that took place in the economy, economists have returned to the central idea that the market must be conceived through the prism of pure and perfect competition. The last neoclassic, the English economist A. Marshall, with his model of partial economic balance, puts the beginning of the study of the concrete situations of the competition, introducing and defining for the first time the notion of economies of scale. Thus, it is found that the market is not simply a land of informal meeting of anonymous individuals, who did not possess any power to influence the exchange structures, specific to the market with pure and perfect competition. All insisted on the important exercise of the principle of freedom of competition, as a fundamental condition of a viable market economy. They asserted that only through competition the market mechanism is realized and a state intervention on the correction of certain deviations from the pure competition model could affect the economic processes [Marshall A., 1920: 54] J. Robinson and E.H. Chamberlin studied one of the forms of imperfect competition, monopolistic competition. Their studies concluded that the presence of a higher number of bidders is not unusual for a competitive market balance. They argue that, by differentiating the products, caused by the presence of advertising and economies, the determination of prices, and the oligopolistic coordination allows them to avoid excessive competition and ensures maximum profits [Chamberlin E. H., 1958].

J. Schumpeter in 1950, gives a new vision to the nature of competition. Namely, he considers that competition is the engine of the creative destruction process and consequently of economic progress. The pioneering companies introduce new products and new production methods, thus opening new markets. The dynamism of these companies initially gives them a monopolistic position on the market, while stimulating others to imitate them. These successive innovations and imitations promote economic progress. Viewed from the perspective of competition as a dynamic process, deviations from the perfect competition model, such as product differentiation and lack of transparency on the market, are premised on the "workability" of that process [Schumpeter J., 1994]. Competition theory becomes one of the central concepts of economic orthodoxy, studies on competition being present in the neoclassical L. Walras, A. Cournot, Bertrand, V. Pareto, Edgeworth, A. Marshall. One of the greatest merits of the marginalists is the elaboration of the concept of pure and perfect competition, elaborated by the representative of the mathematical school L. Walras. His model allowed the analysis "in a pure state" of the mechanism of price formation under conditions of free competition. Proponents of another conception, for example Schumpeter, consider that competition is a means to achieve certain objectives: the general good, a better distribution of resources. The emergence of price theory in the nineteenth century determined the development of the structural and static notion of competition: pure and perfect competition [Boulouis J. *et al*., 2002]. Other authors examine competition as something complex, which, on the one hand, represents the competition (rivalry) between independent economic subjects in order to attract the clientele, which

constitutes its subjective side; and on the other hand, it is a mechanism for the realization of the laws of the market economy (supply and demand), competition of capital and effective means of administration, which constitutes the objective side. [Khemani R.S., Shapiro D.M., 1995: 99].

In the second half of the twentieth century, due to the changes taking place in the national and international competition environment, the debates on competition are expanding. In the Republic of Moldova, the system of legal regulation of competition protection originates at the beginning of the 90s of the 20th century through the approval of the Government Decision R.S.S. Moldova no.2 of 04.01.1991. Regarding the urgent measures to the demonopolization of the national economy of Moldova, which declares as one of the main directions of the economy the development of the spirit of competition and the limitation of the monopolistic activity. Subsequently, the Law of the Republic of Moldova was approved on limiting the monopoly activity and developing the competition no. 906 – XII of 29.01.1992, which established the organizational and legal bases of the development of competition, the measures of prevention, limitation and repression of the monopolistic activity and is oriented towards ensuring the conditions for the creation and functioning of the market economy in the Republic of Moldova. Due to the fact that the aforementioned law was more declarative, on June 30, 2000, the Law on the protection of competition no. 1103 was approved, which established a separate body to deal with the protection of competition. Based on the economic content of the concept of competition, many authors define the concept of competitiveness, focusing their attention on its various aspects. It should be noted that a single universally recognized in the scientific community and management practice definition of competitiveness, as well as competition, able to comprehensively reflect its essence as an economic category, currently does not exist. Currently, there are a large number of definitions of the concept of competitiveness, among which:

- competitiveness is the country's ability, within the framework of free and fair market conditions, to produce goods and services that can meet the requirements of the international market [2];
- competitiveness is the ability to produce goods and services that meet the demand in international markets, at the same time, providing citizens with a high standard of living and the possibility of maintaining it in the long term [7];
- competitiveness – supporting the ability of companies, enterprises, regions, countries and supranational regions to maintain, while open to international competition, a relatively high level of income and employment[4];
- competitiveness is an area of economic knowledge that analyzes the facts and policies that shape the country's ability to create and maintain conditions that ensure the creation of additional value by enterprises and a higher level of well-being of the population[15];

- competitiveness of a company is the real and potential ability of a company to design, manufacture and sell under the conditions in which they have to operate, goods that, in terms of "price" and "non-price" characteristics, are more attractive to consumers than competitors;
- competitiveness is a dynamic characteristic, that is, it is not constant over time, due to the constantly changing competitive environment, it is multi-level in nature (micro-, meso- and macro levels, each of which uses its own set of characteristics to determine the competitiveness of entities) [Porter M.E., 1998];
- enterprise competitiveness is a complex concept, which is determined by the system and quality of management, product quality, breadth and depth of the assortment demanded by society or its individual members, stable financial condition, ability to innovate, efficient use of resources, purposeful work with personnel, level of goods distribution and service system company image [Garelli S., 2002];
- competitiveness is a property of an object that characterizes the degree of satisfaction of a specific need in comparison with the best similar objects, that is, the ability to withstand competition in comparison with similar objects in a specific market and others.

In the scientific literature, the concept of "enterprise competitiveness" is considered from three points of view: 1) Definitions of the organization's competitiveness, characterizing the internal and external activities of the company, without mentioning the product. 2) Definitions based only on the product component of competitiveness. An organization's competitiveness is its ability to produce a competitive product or service. 3) Definitions combining product and production activities of a subject. The competitiveness of an enterpriseis a relative characteristic that reflects the differences in the development process of a given manufacturer from a competitor's producer, both in terms of the degree to which their goods or services satisfy a specific social need, in terms of production efficiency.

The competitiveness of entrepreneurial structures reflects their ability to be flexible and adaptable to constant changes in the external environment in order to increase, decrease or maintain their market share. Since the competitiveness of an enterprise depends both on its activities and on its external environment, it is necessary to isolate and analyze factors that have a significant impact on it. Thus, the factors of competitiveness of enterprise structures are understood as the phenomena or processes of the production and economic activity of the enterprise and the socio-economic life of society, which cause changes in the absolute and relative magnitude of the costs of production and sales of products, and as a result, a change in the level of competitiveness of the enterprise itself. In general terms, the organization's competitiveness factors are divided into external, to a small extent, depending on the organization, and internal, almost entirely dependent on the organization's leadership. External factors are the socio-economic and organizational

relations involved in the creation of products that are more attractive in terms of price and non-price. They include: measures of state influence: of an economic nature (tax, financial and credit, investment policy, etc.); administrative nature (development, improvement and implementation of legislative legal protection of consumer interests); main characteristics of the market for the activities of the enterprise; activities of public and non-governmental institutions; the activities of political parties, movements, blocs that form the socio-economic situation in the country. Internal factors are objective criteria that determine the ability of an enterprise to ensure its own competitiveness. These include: the potential of marketing services; scientific and technical potential; production and technological potential; financial and economic potential; personnel potential (structure, professionally qualified staff); the effectiveness of advertising and sales promotion tools; level of logistics and others). Among the internal factors of the organization's competitiveness, the level of organization management quality plays an important role the level of training of managers, the ability to conduct business correctly in a constantly changing market. These factors are considered key in determining the competitiveness of an organization in the market.

At the same time, in accordance with the model of M. Porter, the following groups of factors are taken into account: rivalry among sellers competing in this market; competition from substitute products; the threat of new competitors; positions of suppliers, their economic opportunities; consumer positions, their economic opportunities [Porter M.E., 1998: 54].

According to M. Porter, it is important to distinguish competitiveness due to innate factors and achieved through other sources. All the factors affecting the competitiveness of the enterprise, M. Porter suggests dividing into: the main ones are natural resources, climatic conditions, the country's geographical position, unskilled labor and developed modern information exchange infrastructure, highly qualified personnel, high-tech industries; general is a system of roads, debit capital, personnel with higher education, and specialized is highly specialized personnel, specific infrastructure, databases in certain fields of knowledge, other factors used in one or a limited number of industries; natural and artificially created. The disadvantage of the classification of competitiveness factors proposed by M. Porter is that he identifies only one sign of dividing them into groups (general and specialized), without indicating by which principle the main, developed , natural and artificially created factors.

Each of the factors characterizing competition in the market is estimated by experts on a point scale. Managers and leading specialists of the enterprise can be involved as experts. For example, if a factor does not appear on the market or there are no signs of its manifestation, then the strength of the manifestation of this factor is estimated at 1 point; if the factor is weakly manifested – 2 points; if the factor is clearly manifested – 3 points. To take into account the relative importance of various factors, the specific "weight" of each of them is determined directly

during the analysis. Thus obtained assessment of the degree of influence of each of the five forces of competition in the market is a weighted average score:

$$\bar{b} = \frac{1}{m \times n_i} \sum_{i=1}^{m} k_i \sum_{j=1}^{n} b_{ij}$$

Where: b_{ij} – pointscoreofthej-thexpertofthedegreeofmanifestationofthei-thfactor; n – number of experts; k_i– factor of importance of the i-th factor, m– number of factors considered.

Based on the received average score, conclusions are drawn. In addition, at the stage of analysis of competition factors, a forecast is made for the development of competition in the market based on forecast estimates of changes in the action of each of the factors. A forecast estimate of the change in the factor's action corresponds, for example, to the following scores: "+1" - if the factor's effect increases, "0" - remains stable, "–1" - weakens. Based on the received expert assessments of the forecast for the development of each of the factors, a weighted average estimate of the forecast for the development of competition forces in the market is determined:

$$\hat{c} = \frac{1}{m \times n} \sum_{i=1}^{m} k_i \sum_{j=1}^{n} c_{ij}$$

Where:c_{ij} – score of the j-th expert forecast for the development of the i-th factor; n – number of experts; k_i – factor of importance of the i-th factor; m – number of factors considered.

In the case when the weighted average estimate of the forecast falls within the interval (0.25 ÷ 1), a conclusion is made about increasing the level of competition in the market, (–0.25 ÷ 0.25) – the level of competition will remain stable, (–1 ÷ - 0.25) –decrease

In addition to determining the factors of enterprise competitiveness, an assessment of the intensity of competition is necessary. For this, a set of indicators is used that determine the level of competitiveness of a particular product in the market, namely:

- The financial indicators include: cost, rate of return, assessment of the structure of assets, investment attractiveness, return on invested capital and other financial indicators.
- Production indicators include: capital productivity indicators; production capacities, use of equipment, number of employees, quality control systems, productivity.
- Organizational and managerial indicators include: the labor productivity of workers, the proportion of engineering and technical workers and specialists from the total number of employees, the speed of the management response to changes in the external environment, the clear division of responsibilities, and the type of organizational structure of management.

- Marketing indicators include: market share, brand prestige, company reputation, strategies, number of customers, pricing policy and price level, quality of service.
- Technological indicators include: new products, applicable standards, expenses for research and development work.
- Indicators of personnel include: the level of qualification of personnel, as well as the level of training of sales personnel in the technical field.

The proposed indicators can be calculated both for an individual enterprise, and for a strategic group or a set of industrial enterprises that form the industry of industrial production with the derivation of general analytical indicators for the analysis of competition at the micro and macro levels. Thus, the competitiveness of a business entity is a multifaceted economic category, which is the main criterion for assessing the effectiveness of production, work or services, as well as the resulting indicator of the effectiveness of the management system of this business entity.

3. Methodological aspects of assessing the competitiveness of the enterprise

The competitiveness of the enterprise reflects the aggregate results of the work of all its divisions, the state of their material base, the reliability of personnel and financial support, the level of management and the ability of the enterprise to respond to changes in external factors of influence, the ability to adequately and quickly respond to changes in customer behavior, their tastes and preferences. The solution to the problem of increasing competitiveness is inextricably linked with the assessment of the level of competitiveness.

The analysis of economic literature indicates the ambiguity of methodological approaches to the study of competitiveness, which also determine the multiplicity of the methods used to assess it. So, today there are a number of methods for assessing the competitiveness of an enterprise. Among many approaches, two principal ones can be distinguished – quantitative and qualitative.

Quantitative methods for assessing competitiveness, as a rule, are associated with the calculation of indices, primarily integral, designed to assess the state of a number of key indicators that reflect individual aspects of competitiveness, with their subsequent integration into an aggregate indicator. They are based on the use of various coefficients for the analysis of production activities, financial situation, investment efficiency and others, while the indicators are quite diverse. It is proposed to use the following quantitative parameters: economic potential and performance; management level; production and marketing potentials, indicating the ability of the company to produce and sell this or that product in the required quantities at the required time; research potential; financial position. At the same time, a comprehensive assessment method is based on indicators of the effectiveness of the production activities of the enterprise; financial situation; the

effectiveness of the organization of marketing and promotion of goods on the market; product competitiveness; business activity. The enterprise competitiveness coefficient is calculated as the sum of the products of the value of a particular criterion by its weighting coefficient.

Qualitative methods are not associated with quantitative calculations, but are based on expert estimates. The most universal and operational method of assessing the competitiveness of an enterprise is a SWOT analysis, which allows you to most fully compare the competitiveness indicators of a market entity with similar indicators of your rivals, to identify and evaluate your own strengths and weaknesses, as well as the strengths and weaknesses of your competitors.

Currently, the following main methods for assessing the competitiveness of enterprises can be distinguished. Based on the fact that the competition of companies in a market economy takes the form of competition of products, and the ability of a company to compete in a particular product market directly depends on the competitiveness of its product, the competitiveness of an enterprise can be assessed using product methods. To determine the competitiveness of products, various marketing and qualim etric methods are used, most of which are based on finding the price-quality ratio of products. The enterprise competitiveness indicator, as a rule, is determined by finding the weighted average value among the competitiveness indicators for each type of product, where sales volumes of the corresponding type of product are used as weights according to the formula:

$$K = \Sigma a_i x k_i$$

Where: K– enterprise competitiveness; a_i – specific weight of i-type product in total sales; k_i – i-product competitiveness.

Moreover, the calculation of the competitiveness indicator for each type of product is carried out by finding the ratio of the parametric and economic indices, which are a combined assessment of the technical (quality) parameters of the product, economic – cost. In turn, the calculation of these indices is carried out by adding the private indices for each evaluated parameter, taking into account the assigned weighting factors. The list of cost and technical parameters, as well as the weight of each of the parameters is established by experts. At the same time, the method of determining the competitiveness of an enterprise based on assessing the competitiveness of products, taking into account the weight of sales in various markets, can be determined by the formula:

$$K = \sum_{i=1}^{n} aixbixKij$$

Where: a_i – the proportion of the i-th product of the enterprise in the volume of all sales for the analyzed period, unit shares; b_i– indicator of the importance of the market in which the goods of the enterprise are sold; K_{ij}– competitiveness of the i-th product in the j-th market.

The above methods take into account one of the most important conditions for achieving enterprise competitiveness - the competitiveness of manufactured

products, but assessing the competitiveness of an enterprise through an assessment of the competitiveness of products allows you to get a very limited idea of the disadvantages and advantages in the activities of the enterprise itself. It is important to note the fact that when calculating the competitiveness index, indirect (generalized) indicators or a system of indicators are used, which significantly reduces the value of this method and limits the possibility of its application.

With the complexity of the composition and structure of key competencies, enterprises are faced with the need to assess the competitiveness of the company, taking into account the full range of its functions and long-term goals. In this connection, the Boston Consulting Group (BKG) in the 1960s, as an analysis tool, proposed a matrix model for assessing the competitiveness of economic entities growth – share matrix. This method is based on evaluating the marketing strategy of an enterprise based on building a matrix of competitive strategies. The methodology is based on an analysis of the enterprise's competitiveness based on the life cycle of the enterprise's products and growth indicators of demand and market share compared to the share of a leading competitor.

The essence of the assessment is to analyze the matrix, built on the principle of a coordinate system: horizontally – growth (reduction) in sales; vertical – the relative market share of the enterprise. Moreover, the relative market share is the ratio of the share of the enterprise to the share of the largest competitor in the market of the relevant industry. The most competitive companies are those that occupy a significant share in the fast-growing market. The matrix reflects the financial interactions within the company's portfolio and the financial considerations that should be taken into account, and also explains why priorities in the allocation of resources between individual enterprises of the company may vary. It also provides a good basis for strategies for expanding or abandoning certain activities (products).

The considered method makes it possible to assess the competitiveness of the enterprise under study, establish the features of the development of a competitive situation and develop a preferred behavior strategy. Advantages of the method: if there is reliable information about sales volumes and relative market shares of competitors, the method allows for a high representativeness of the assessment. The disadvantages of the method: it eliminates the analysis of the causes of what is happening and complicates the development of managerial decisions, and also requires reliable marketing information, which entails the need for appropriate research.

Following the Boston Consulting Group, McKinsey & Co in the 1970s developed a strategic analysis matrix, which, unlike the Boston model, which has a dimension of [2 × 2], has a large dimension [3 × 3] and is built in the "attractiveness – competitiveness" axes. At the same time, competitiveness analysis is carried out by constructing a matrix based on the optimization of the ratio of "product competitiveness" and "market share" occupied by the enterprise. A quantitative assessment of attractiveness serves as the basis for assigning them to one of the nine cells of the matrix. Moreover, the area of circles is proportional to the size of

the industry, and the numbers in them reflect the share of the enterprise. Favorable zones in the matrix mean that, in this sector, the competitiveness of an enterprise is determined by the competitiveness of its products. Competitiveness in this case is expressed by the specific gravity of the enterprise in this market segment, the possession of information about the market, competitors, end users, the level of organization and technology of production and labor. Adverse – that in the absence of opportunities for the enterprise to increase its level of competitiveness, it should leave this segment of the market. In the risk zone, the enterprise needs to take measures to increase competitiveness or move to a more favorable market segment. Therefore, by analyzing its product portfolio using the McKinsey matrix, a company can evaluate its current competitiveness and determine a strategy for each of the elements of its product portfolio. By increasing the number of factors evaluated, the McKinsey matrix provides a more accurate picture of the attractiveness of market segments and the competitive status of the analyzed enterprise.

Shell model is very similar to the McKinsey matrix, being the development of the idea of strategic business positioning. A feature of the Shell matrix is the assumption that the market is an oligopoly. Therefore, for business units with weak competitive positions, an instant or gradual exit strategy is recommended. The attractiveness of the industry also implies the existence of a long-term development potential for all market participants, and not just for the enterprise in question. The Shell model is a [3 × 3] matrix and built in the axes "Industry Perspectives" – "Competitive Position". As in the McKinsey model, each of the measurements is determined by finding a multifactor rating indicator. At the same time, the Shell model places even greater emphasis on the quantitative parameters of the business.

Many economists attribute the SWOT analysis method developed by C. Andrews to matrix methods. The classic SWOT analysis involves the determination of strengths and weaknesses, the internal environment of the enterprise, potential threats and favorable opportunities of the external environment. The form of presentation of the results of such an analysis is a tabular (matrix) representation of Strengths and Weaknesses, as well as Opportunities and Threats of the enterprise environment. Identification of the strengths and weaknesses of the enterprise, of course, is close in scope to the analysis of the enterprise's competitiveness, but the SWOT analysis is more an economic tool for planning the enterprise's strategy and allows assessing the competitive environment of the enterprise rather than its competitiveness".

The selection of methods for assessing the competitiveness of enterprises, based on the theory of effective competition (operational methods) as an independent tool for assessing the competitiveness of business entities, occurred as a development of the tools of matrix models of strategic planning. The essence of the approach is to assess the ability of the enterprise to ensure competitiveness. Each of the enterprise's ability to achieve competitive advantages formulated during a preliminary analysis is evaluated by experts in terms of available resources. At the same time, the composition and structure of the evaluated abilities vary significantly in different

methods: from cost and financial stability indicators to the ability of an enterprise to adapt to innovations. In accordance with the operational approach, those enterprises where the work of all departments and services are best organized are the most competitive. The effectiveness of each service is influenced by many factors – the resources of the enterprise. Evaluation of the effectiveness of each of the units involves an assessment of the effectiveness of its use of these resources. The method is based on the assessment of four group indicators of competitiveness. The first group includes indicators characterizing the efficiency of the production process management, the second group includes indicators reflecting the efficiency of working capital management, the third group includes indicators that provide an idea of the effectiveness of sales management and promotion of goods on the market by means of advertising and incentives, and the fourth group includes indicators product competitiveness: product quality and price.

In the future, in order to assess the competitiveness of the enterprise, the resulting expert assessments are subjected to mathematical processing. Typically, the indicator is found by calculating the weighted average of the obtained expert estimates, taking into account the specific gravity that is assigned to each of the evaluated abilities in achieving the competitive advantages of the enterprise. The calculation of the integral indicator of enterprise competitiveness, using the main groups of weighted average indicators of enterprise competitiveness, is carried out according to the formula:

$$K = a \times Epr + b \times Fp + c \times Em + d \times Kp$$

Where: K– enterprise competitiveness coefficient; Epr – the value of the criterion of the effectiveness of production activities of the enterprise; Fp – the value of the criterion of the financial position of the enterprise; Em – the value of the criterion of the effectiveness of marketing and product promotion on the market; K_T – the value of the criterion of product competitiveness; a, b, c, d – criteria weighting factors.

This assessment of the competitiveness of the enterprise covers all the most important indicators of the economic activity of the enterprise, eliminates duplication of individual indicators, and allows you to quickly and objectively get a picture of the position of the enterprise in the industry market. The use of comparison of indicators for different periods of time during the evaluation makes it possible to use this method as an option for the operational control of individual services. However, this formula does not take into account the attitude of consumers of a given product to the quality of goods produced at a given enterprise.

Assessing the competitiveness of an enterprise by complex methods is based on identifying the current and potential competitiveness of an economic entity. The grouping of parameters is based on the analysis of a wide range of problems of a technical, economic and social nature, as a result of which variables that ensure competitiveness are identified. The starting point of the analysis is to determine the list of technical and economic factors of competitiveness. Competitive advantages

that determine the market position of an enterprise are grouped into six aspects: product competitiveness; financial condition of the enterprise; marketing effectiveness; return on sales; company image; management effectiveness.

Assessment of the competitiveness of the goods is made by comparing the parameters of the analyzed products with the parameters of the comparison base. In this case, differential, complex and mixed assessment methods can be used. The differential method is based on the use and comparison of individual quality parameters of the analyzed products and the comparison base by constructing for each of them the corresponding parametric index (J_{Gi}):

$$J_{Gi} = G_i / G_i^e$$

Where: i= l,....n; G_i – the value of the i-th consumer parameter of the evaluated goods; G_i^e – value of the i-th consumer parameter of the estimated sample product.

The complex method is used if a set of parameters describing a property is used to characterize the quality of the goods. Then the parametric index is calculated taking into account the specific gravity of the individual components. In general, the overall product quality indicator can be determined using the composite parametric index (I_G^{Ct}), which is calculated by the formula:

$$I_G = I_G^{Ct} \times \sum_{i=1}^{n} A_i \times J_{Gi}$$

Where: A_i – weight coefficient of the i-th quality indicator; J_{Gi} – parametric index i-th quality indicator.

To assess the competitiveness of the enterprise, it is most appropriate to decompose the initial competitiveness indicator into separate activity centers, and then to decompose each of the obtained competitiveness indicators into cost components. In this case, the indicator of enterprise competitiveness (K) can be represented as follows:

$$K = \sum_{l=1}^{k} Y_l \times A_l \times K_I^l \times \sum_{i=1}^{n} k_i \, y_i$$

Where: Y_l – weight coefficient that determines the influence of each of the separate activity centers on the formation of a general indicator of enterprise competitiveness; A_l – weight coefficient that determines the impact of each activity center on the formation of a general indicator of enterprise competitiveness; $K_I^{\,l}$ – strategic positioning coefficient of the l-th activity center; k_i – relative efficiency of the i-th cost element;γ_i – the weight coefficient of the i-th cost element, which determines the relative weight of the relative effectiveness of each of the cost elements in the overall coefficient of operational efficiency.

The determination of weight coefficients of both individual characteristics as part of complex indicators and for individual quality indicators should be carried

out on the basis of expert assessments, which are specified in the process of monitoring consumer behavior.

It should be noted that various weighting coefficients obtained as a result of the above algebraic transformations are of purely mathematical value and are necessary in order to justify the possibility of representing the initial indicator of enterprise competitiveness in the form of a set of private indicators of competitiveness. In other words, for the purposes of economic analysis, there is no need for cumbersome calculations of the corresponding weight coefficients, but it is only necessary to calculate the initial and particular indicators of the enterprise's competitiveness.

The determination of each of the above indicators within the framework of this method is carried out by experts on the basis of various evaluation tables and matrices. The proposed methodology for assessing competitiveness, in contrast to existing methods of this kind, is based on a clearly expressed mathematical apparatus. This gives not an estimated and largely conditional dependence of the indicator on competitiveness factors, but a tough functional relationship. The main advantage of this technique is that the assessment is carried out according to the ultimate criteria of competitiveness – profitability and the company's market share. Using this model for practical purposes reduces the risk of managerial decisions and can serve as the basis for assessing their effectiveness. The proposed methodology is acceptable to justify decisions regarding the management of the current activities of the enterprise, as well as to serve as an argument confirming the feasibility of investment decisions.

Dynamic methods for assessing the competitiveness of an enterprise provide for the analysis of the main indicators of the enterprise's activity in dynamics, since without taking into account changes in time, the value of even the most important indicator does not allow forming an exhaustive idea of the analyzed process. The dynamic approach is based on two principles: the definition of key indicators of the business entity and the application of dynamic analysis in relation to them. This method of assessing competitiveness involves the analysis of the main indicators of the enterprise in dynamics.

The essence of operational efficiency is the implementation of activities similar to competitors in order to ensure profit in the process of realizing surplus value, while the essence of strategic positioning is to create a unique position based on a combination of activities that are different from competitors. By creating, supporting and expanding sales markets, strategic positioning provides the very possibility of the process of realizing surplus value. Highlighting the indicators, which are key indicators of the financial and economic activity of the enterprise, economists certainly agree that these are the profit and revenue of the enterprise. The key indicators are usually considered the profitability of the company (operational efficiency) and the dynamics of the market share (strategic positioning). Then the assessment of the competitiveness of the enterprise can be made according to the following formula:

$$K = K_r \text{ x } K_I$$

Where: K – competitiveness of th estudied enterprise; K_r – operating efficiency ratio; K_I – strategic positioning coefficient.

To assess the operational efficiency of the enterprise, it is necessary to compare the value of the considered indicator of the studied economic entity with the corresponding indicator for the sample:

$$K_r = r / R$$

Where: K_r– operating efficiency ratio.

The higher the K value, the more competitive the sample in question is in relation to the sample. Obviously, $0<K<\infty$. Moreover, if $0<K<1$, the competitiveness of the enterprise in relation to the sample is low (the closer to zero, the lower the competitiveness). With K = 1, the competitiveness of the enterprise is identical to the competitiveness of the sample. At K> 1, the competitiveness of the enterprise is higher than in the sample.

Thus, this method of assessing the competitiveness of an enterprise covers key characteristics of an enterprise, eliminates duplication of assessment parameters and allows, based on the obtained time series, to conduct factor analysis and predict the level of competitiveness of an economic entity. This method of assessing the competitiveness of enterprises is a simple and universal tool for assessing the effectiveness of economic activity, the application of which is possible both in theoretical studies and in the practice of economic analysis.

It is important to note that none of the considered methods for assessing the competitiveness of an enterprise has found wide application in the practice of economic analysis. On the basis of which it can be concluded that a universal method for an integrated assessment of the level and sources of competitiveness of an enterprise has not yet been developed. In our opinion, this is due to the fact that the methods considered have a number of disadvantages. Summarizing the results of the study of methods and criteria for assessing competitiveness, we can conclude that the common drawback of all the methods analyzed is the presence of subjectivity: not all the parameters that are used in the assessment for each method can be quantified.

4. Conclusions

In conclusion, we can mention that the notion of competition must be regarded as a complex, multilateral category, having the right to life and applicability by the competition protection authorities of both approaches: both behavioral, in the case of examining anti-competitive and structural practices, in the case of examining economic concentrations as a preventive measure.

In the context of the above, we consider that competition represents the economic rivalry, existing or potential, between two or more independent companies in a relevant market, when their actions effectively limit the possibilities of each of them to influence unilaterally the general conditions of circulation of the products on the respective market, stimulates the technical-scientific progress and the increase of the consumer's welfare.

Based on the above analyzed, it can be stated that currently there is no single methodology for a comprehensive quantitative assessment of the competitiveness of an enterprise, the need for which is becoming increasingly important. Each of these groups of methods can be used as an assessment of the competitiveness of enterprises in the engineering industry. However, it should be noted that there are no perfect methods and it is necessary to choose one or the other on the basis of the purposes for which the assessment is carried out.

Quantitative methods make it possible to objectively assess the competitive capabilities of an enterprise, but in most cases they are based on an analysis of factors that determine the competitiveness of business entities, the list of which is purely subjective and exhaustive. At the same time, the system of enterprise competitiveness factors is open, and many elements of this system are fuzzy, which indicates a lack of adequacy of the assessment.

In addition, as a rule, technical and economic indicators of various nature are brought together into a single competitive indicator with the assignment of coefficients that determine their weight value to each of the evaluated factors. At the same time, the influence of various economic factors in a particular economic situation on the competitiveness of an enterprise is different.

Qualitative methods do not differ in particular scientific rigor, but they are sensitive, flexible and, subject to the analysis of sufficiently reliable information, allow us to evaluate facts, not abstract figures. The main disadvantage of this group of methods is significant subjectivity and convention, but in some cases their application is necessary and very productive.

Thus, the competitiveness of an enterprise is its superiority in the selected market segments over its competitors at the given moment assessed by environmental entities, achieved without harming others, determined by the competitiveness of its specific products and the level of competitive potential characterizing the ability to develop, manufacture, and sell in the present and future and to service goods (services) that exceed analogues in terms of price / quality.

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CARBON MARKETS AND BLOCKCHAIN TECHNOLOGY

Abstract: *The present study analyses one of the mitigation measures that has been proposed first under the Kyoto Protocol and what effects has it had to enhance climate action. Furthermore, we will have a look over the mechanisms that have been developed for this measure to be implemented and what legal issues have appeared. The main question that I will try to answer is if it has indeed had a positive effect and if the greenhouse gas emissions have gone down. If not, can we implement a system that by using blockchain technology we will get the wanted results? By analyzing the legal barriers of applying such a new technology I will try to determine the opportunity of such a measure and the legal frame that should exist for this to function.*

Key words: *blockchain technology, carbon markets, climate action, greenhouse gas emissions, international treaties, mitigation measures.*

1. Climate change

1.1. Notion

The Industrial Revolution marked a major turning point in Earth's ecology and humans' relationship with their environment. It dramatically changed every aspect of human life and lifestyles. From human development, health and life longevity, to social improvements and the impact on natural resources, public health, energy usage and sanitation, the effects were profound. It wasn't that the Industrial Revolution became a stalwart juggernaut overnight. It started in the mid-1700s in Great Britain when machinery began to replace manual labor. Fossil fuels replaced wind, water and wood, used primarily for the manufacture of textiles and the development of iron making processes.

Unfortunately, in our search of strong economic development and technology improvement we have mistreated a very important element of our life, the environment. More than 200 years of fast-forward movement, where we have witnessed huge changes in the society's structures and lifestyle of the peoples has also caused an increase in the concentration of greenhouse gases in the atmosphere which slowly lead the climate to change.

Climate change is a complex problem, which, although environmental in nature, has consequences for all spheres of existence on our planet. It either impacts on – or is impacted by – global issues, including poverty, economic development, population growth, sustainable development and resource management.

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In the present moment, there is a conceptual error being made when economic growth is equated with environmental degradation, or at the very least, with the increasing consumption of the Earth's resources. Despite their close connection in the past, it is theoretically possible to have limitless economic growth on a finite planet.

I believe, these years to come are crucial decision-making years and any mechanisms we will use will either help us enhance climate action or will determine even worse climate change consequences that we have not experienced till now. The biggest "enemy" is the growing level of greenhouse gas emissions. In March 2019 the level of CO_2 emissions reached the highest point after the Industrial Revolution, 411.66 ppm. This is a sign, that with all the discussions, treaties and partially applied measures we still did not manage to peak the emissions level.

Without serious policy changes, scientists expect devastating consequences in many regions: inundation of coastal cities; greater risks to food production and, hence, malnutrition; unprecedented heat waves; greater risk of high-intensity cyclones; many climate refugees; and irreversible loss of biodiversity. Some international relations scholars expect increased risk of violent conflicts over scarce resources due to state breakdown.[2]

The sensitivity of such a topic is highlighted in one of my favorite scientific books called "The Medea Hypothesis: Is Life on Earth Ultimately Self-destructive?" by Peter Ward. The main theory debated in the book is the Gaia hypothesis which states that biological processes should tightly regulate the composition of the atmosphere and therefore keep it relatively stable (not see appreciable changes in oxygen or carbon dioxide levels over time). The author conducted numerous researches in the ice caps of the planet and found out that this is not quite the case. On the contrary, it showed that has been a 35% increase in the atmospheric CO_2 since preindustrial times but rates of carbon uptake into the biosphere have accelerated by only about 2%. This tell us that even if the planet has carbon sinks and can indeed keep a balance, it is only till a crucial point, when the emissions go over a certain level, different natural processes of destruction start. Horror cases of mass extinctions are being presented in the book as an effect of the high levels of greenhouse gases.

1.2. International treaties

After the Second World War, the rising levels of greenhouse gases have triggered big debates on the international stage. Because of the reports and the concerns of the scientists, in 1961 the United Nations General Assembly called on the World Meteorological Organization (WMO) and the non-governmental

[2] Andrei Marcu (2017). Governance of Article 6 of the Paris Agreement and Lessons Learned from the Kyoto Protocol. p. VII. Center for International Governance Innovation. Fixing Climate Governance Series. Paper no.4.

International Council for Science (ICSU) to collaborate in developing the new scientific and technological opportunities for monitoring, predicting and eventually controlling, weather and climate and triggered the twin birth of the WMO World Weather Watch and the WMO/ICSU Global Atmospheric Research Program (GARP).

More years and more conferences after, a text for the UN Framework on Climate Change Convention was drafted and got signed by 155 countries at the Rio Earth Summit in June 1992. The signing of this convention marked an important step in bringing even more awareness of the consequences of greenhouse gas emissions. Several guiding measures were developed to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects but it seemed to be more of a recommendation then an actual obligation.

Unfortunately, by the year 1997 it was clear that things are moving at a very slow pace, with not much impact to be felt. On the contrary, the levels of greenhouse gases kept on rising. A stronger effect was needed, so at the 3rd Conference of Parties in December 1997 which took place at Kyoto, Japan a new protocol was shaped, the Kyoto Protocol.

The Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets[3]. Owing to a complex ratification process, it entered into force on 16 February 2005.

One important new element needs to be highlighted and that is the establishment of flexible market mechanisms, which are based on the trade of emissions permits. Kyoto Protocol Parties bound to targets are required to meet them largely through domestic action – that is, by reducing their emissions at home. But they can meet part of their targets through three market-based mechanisms that ideally encourage greenhouse gases abatement to start where it is most cost-effective, for example, in the developing world. It does not matter where emissions are reduced, if they are removed from the atmosphere.

The three economically viable, flexible supplementary mechanisms established "to reduce the emission of certain harmful anthropogenic gases" are: the emissions trading system (ETS), the clean development mechanism, (CDM) and joint implementation (JI).

Even if a more complex solution plan was developed, years after the entering into force of the Kyoto Protocol (2005), the international governing bodies and scientists were getting information about the impact and raising level of greenhouse gas emissions. In the frame of all these acknowledgments, the Paris Agreement was being negotiated by representatives of 196 state parties at the 21st Conference of the Parties of the UNFCCC in Le Bourget, near Paris, France, and was adopted by consensus on 12 December 2015.

[3] What is the Kyoto Protocol? retrieved from https://unfccc.int/process-and-meetings/the-kyoto-protocol/what-is-the-kyoto-protocol/what-is-the-kyoto-protocol

As of July 2018, 195 UNFCCC members have signed the agreement, and 180 have become party to it. The Paris Agreement's long-term goal is to keep the increase in global average temperature to well below 2°C above pre-industrial levels; and to limit the increase to 1.5°C, since this would substantially reduce the risks and effects of climate change. "Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production while making finance flows consistent with a pathway towards low greenhouse gas emissions and climate resilient development are the other 2 goals set up in order to fight climate change[4]".

As emissions reduction is accepted as a mechanism for abating global warming to internationally accepted levels, the UNFCCC Conference of the Parties held in December 2015 ("COP 21") heralded the shift in focus, scope and solutions to address the ultimate impact of increasing GHG emissions to respond to the potentially physically, economically and socially catastrophic consequences of climate change. Even more, the Paris Agreement is further reaching than the Kyoto Protocol, aiming to strengthen the ability of countries to deal with the impacts of climate change through 'appropriate financial flows, a new technology framework and an enhanced capacity building framework' to support action by developing countries and the most vulnerable countries 'in line with their own national objectives'. Under the Paris Agreement, each participating country is required to establish a nationally determined contribution ("NDCs"), which outlines its objectives to combat climate change. Importantly, and in contrast to the Kyoto Protocol, NDCs are a 'best efforts' commitment and not legally-binding.[5]

2. Emissions trading system (Carbon markets)

2.1. Notion

Under the Kyoto Protocol, countries' actual emissions must be monitored, and precise records must be kept of the trades carried out. Registry systems track and record transactions by Parties under the mechanisms. The UN Climate Change Secretariat, based in Bonn, Germany, keeps an international transaction log to verify that transactions are consistent with the rules of the Protocol. Reporting is done by Parties by submitting annual emission inventories and national reports under the Protocol at regular intervals.[6]

As we saw in the previous chapter, the parties with commitments under the Kyoto Protocol have accepted targets for limiting or reducing emissions. These

[4] Art. 2 of the Paris Agreement;

[5] Tallat Hussain, Ingrid York and James Read. (2016). What is the future of emissions trading? White&Case. Environment&Climate Change Report.

[6] What is the Kyoto Protocol? retrieved from https://unfccc.int/process-and-meetings/the-kyoto-protocol/what-is-the-kyoto-protocol/what-is-the-kyoto-protocol.

targets are expressed as levels of allowed emissions, or "assigned amounts", over the 2008–2012 commitment period. The allowed emissions are divided into "assigned amount units" (AAUs). The mechanism thought allows countries which have spare emission units (carbon credits) to sell them to other countries that are over their target.

As an effect of the Kyoto protocol, a new commodity has been established in the form of emissions removals. Because the main greenhouse gas traded is carbon dioxide, the mechanism received the name of carbon market.

"More than actual emissions units can be traded and sold under the Kyoto Protocol's emissions trading scheme. The other units which may be transferred under the scheme, each equal to one ton of CO_2, may be in the form of: a removal unit (RMU) based on land use, land-use change and forestry (LULUCF) activities such as reforestation; an emission reduction unit (ERU) generated by a joint implementation project; a certified emission reduction (CER) generated from a clean development mechanism project activity; [7]"

All transfers and acquisitions of these units are tracked and recorded through the registry systems under the Kyoto Protocol.

2.2. Effects

None of the treaties or measures had a significant impact; on the contrary they offered a lot of opportunities for the countries to escape their obligations.

One big issue is first the lack of an enforcement mechanism that would make countries comply with their duties. Again, a big change in greenhouse gas emissions has not happened and the measures offered were misused. In my opinion they were never meant to actual solve the problem and with a lack of control, strict procedures and serious checkups they have created harm to the environment.

Related to carbon trading, for the countries that set up the cap and where the obligations of the companies were set up a question remains, if those companies went over the carbon credit allowances, were there any serious consequences? And what was to be done to reach that cap of the market that was set. Even if some countries applied some administrative penalties which resulted in certain amounts of money, were they used to develop other projects that enhanced climate action? A clear answer has not been found.

The trading emission scheme has been conceived as a market. The actual developers of the idea are said to be big players of the Wall Street stock market like Goldman sacks and the big energy trading company Enron. By the way it is constructed may be so. While I am not totally against it, I only see the use for just a transition period till complete clean energy system is adopted if we respect that maximum cap and do not create mechanism to get extra "pollution permits".

Some argue that applying this mechanism it will be easier to buy credits than to reduce emissions and then it will just be a license to pollute. This was partially

[7] International emissions trading retrieved from https://unfccc.int/international-emissions-trading.

my concern too and unfortunately after 14 years we can see that it was for sure not effective. And this is not the only problem.

The cap and trade system is a financial bubble; the creators get big commissions on the transactions from the carbon stock market. Governments are distributed certain permits to pollute every year, which will be less and less as we progress. The idea was it does not matter who pollutes if we keep our cap. In this context some companies would innovate while others that would not and would go over the permitted carbon emissions would need to buy extra carbon credits (this is where the trading comes in and the creators get their commission). In this way the company that innovates is rewarded why the one that pollutes is "sanctioned". But not everything worked so smoothly.

Even the creator of this stated it is not a solution for climate change; biggest problems lay in the details of the proposal: vast polluters got these permits for free to assure the continuous development of the economy. The cap and giveaway system in Europe made the value of the permits jump like crazy, the energy prices went up for consumers and more emissions were created. And the polluters made millions of dollars in profit. This is for sure not a solution and those permits should have been sold and the money be used to develop projects that would have influenced the reduction of greenhouse gas emissions.

Another carbon trading market mechanism that was used is offsetting. A company which reduces or removes carbon will get an offset carbon permit which can again be sold. The problem was how to guarantee that the actual company reduced that carbon because the procedures of assessment were loose, and it was very difficult to verify. These permits were still given and sold. This led to the creation of false offsets and companies started to cheat. E.g.: In Indonesia massive corporations cut down indigenous forests causing massive ecological and cultural destructions (a lot of species are almost extinct) and on the waste land created they planted palm oil trees for which they can get carbon offsets permits. It is useless to point out how this mechanism double rewarded some of the big destructors of these planets, the corporations.

2.3. Carbon markets 2.0 – the Paris Agreement

Carbon markets are now moving into a 2.0 phase. The fact that serious issues exist is evident in current symptoms: a freeze in international activity and virtual disappearance of the international component of the carbon market. In a "normal and clear world," both sovereign states (Parties to the Paris Agreement) and private companies would have already started to work on hedging their carbon risk, using contributions that could be counted toward the NDCs. The lack of interest in international transactions is partly due to the lack of demand to meet obligations under the second commitment period of the Kyoto Protocol and the Cancun commitments. However, another and more important cause is the lack of clarity on

the governance of markets for the Paris Agreement, including how it will interact with domestic markets[8].

Art. 6 "(1) Parties recognize that some Parties choose to pursue voluntary cooperation in the implementation of their nationally determined contributions to allow for higher ambition in their mitigation and adaptation actions and to promote sustainable development and environmental integrity. (2) Parties shall, where engaging on a voluntary basis in cooperative approaches that involve the use of internationally transferred mitigation outcomes towards nationally determined contributions, promote sustainable development and ensure environmental integrity and transparency, including in governance, and shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement. (3) The use of internationally transferred mitigation outcomes (another word for carbon credits) to achieve nationally determined contributions under this Agreement shall be voluntary and authorized by participating Parties (…)."

The new framework for cooperative approaches and mechanisms under Article 6 of the Paris Agreement charts a path for the resurgence of carbon markets. However, the modalities, rules, and guidance are yet to be fully elaborated by the Parties to the Paris Agreement.

One of the biggest problems of the Paris Agreement in general and which still continues to exist after the Conference of parties (COP) number 24 meeting at Katowice is the fact that while the countries managed to put together a skeleton of an agreement in Paris they haven't decided back then how to implement the provisions. Many have described this meeting as the most important UN talks since Paris – "the moment," as David Waskow, director of the Climate Initiative at the World Resources Institutes, puts it "to bring life into all of the dimensions of the Paris Agreement".

Unfortunately, after the meeting, negotiators were unable to reach an agreement on guidelines implementing Article 6 of the Agreement, which allows for "internationally transferred mitigation outcomes," thereby opening the door to linking of carbon markets through voluntary market mechanisms. In theory, these market-based mechanisms would provide more creative and flexible pathways to deeper reductions in global carbon emissions by linking emissions trading systems around the world (e.g., carbon trading) and by instituting emission credit systems like the Clean Development Mechanism (CDM) under the Kyoto Protocol. Although much progress has been made since implementation of the CDM, implementation of Article 6 has been fraught with contention, in part due to concerns that developed nations will continue to emit and rely upon reductions achieved by developing nations to satisfy their own NDCs[9]. The implementation of

[8] Andrei Marcu (2017). Governance of Article 6 of the Paris Agreement and Lessons Learned from the Kyoto Protocol. p. 2. Center for International Governance Innovation. Fixing Climate Governance Series. Paper no. 4.

[9] Mary Yang (2018). COP 24 Round-Up Part One: The Paris Rulebook. Covington & Burling LLP.

art. 6 has been postponed for the COP 25 meeting in Chile. This is a pretty bad decision considering all the previous effects under Kyoto Protocol which continue to exist today.

2.4. European Union Emissions Trading System (EU ETS)

In the frame of the adoption of the Kyoto Protocol the European Union has set up the EU ETS. It is a cornerstone of the EU's policy to combat climate change and it is a key tool in the fight against climate change. It was the first major carbon market (set up in 2005) and till the present moment remains the biggest one.

The principle that is the base of this market is the 'cap and trade' principle. A cap is set on the total amount of certain greenhouse gases that can be emitted by installations covered by the system. The cap is reduced over time so that total emissions fall.[10]

In the European Union System, within the cap set up, companies receive or buy emissions allowances to pollute. These emissions can either be used by the company or traded with another one as needed. The companies can also buy limited amounts of internationals credits from projects that can be qualified as emissions-saving. The problem with this system is that it has been imposed as a mandatory system to big power stations, industrial plants and air lines. Unfortunately, this system for now does not cover very 2 important sectors which are transportation and livestock farming. The explanation of such a decision can be traced back to the lifestyle of the modern European. Unfortunately, we are living in a society where in our diets it is a consistency to consume animal products (especially beef) and a lot of us own a personal car which we use every day. Although the education on climate change effects and consequences of the European citizen is set up as a high desideratum very few programs have been developed and not a huge impact has been felt among the behavior of most of them. I believe this is one of the biggest problems in succeeding with any measure that we intend to take. If there is a request from the population to consume certain services and goods, there will always be a provider. The easiest way to decrease the greenhouse gas emissions is by far informing the people, setting up an example by the leaders and creating alternative environmentally friendly options that would naturally create an impact.

That doesn't mean that the system of carbon emissions trading hasn't had an impact. From the year 2005 till now it shows an overall decrease of 21%. From the year 2021, phase 4 of the market will be implemented and it is expected by the year 2030 a total of 43% decrease in greenhouse gas emissions compared to the starting year 2005.

Analyzing the future measures to be taken, one is very easy to be noticed; the EU will still be allowing the free allocation of allowances as a safeguard for the international competitiveness of industrial sectors at risk of carbon leakage, further

[10] EU Emissions Trading System (EU ETS) retrieved from https://ec.europa.eu/clima/policies/ets en.

stating that it will be taken into the technological progress of each industry and possibilities of switching to more environmentally friendly procedures. This means that the free allowances will be offered from the year 2021 to the companies that cannot shift their operating mode because of lack of technological development.

For us to understand why, an example may be needed. Let's look at the power plants that burn coal to produce the electricity that is later transmitted through lines to our households and offices for us to consume and use in all the needed activities. We are the ones paying for the electricity in the end. From the moment the mandatory emissions certificates have been imposed, the companies had to also pay money to gain the number of certificates needed to cover their emissions (they did not only get free ones, only in some conditions). In most of the European countries these companies are not state owned anymore, maybe partially but not totally. Their main goal remains making profit. Any additional cost will be reflected in the final cost of not only the electricity but also goods and other services depending on the usage of it.

Paying such taxes when producing a lot of emissions can go to millions of euros, and when the electrical company is already losing a lot of money it can endanger the economic stability of a country if the prices are to go up too fast. For example, one big Romanian electrical company called CA Oltenia had to pay in the year 2018, 296 million euros for emission allowances while it registered a loss of 233 million euros[11]. This determined the Government in the year 2019 to think of a compensation scheme to offset part of the costs of some of the companies which had huge amounts to pay for the purchasing emissions allowances. It sounds weird to support with money from the state the companies that pollute when they are the ones that should be paying, and the money be used to develop the green energy system. Limits and guidelines are set by the European Union for such situations. Of course, we may argue that the environment should prevail, and these companies should not be protected. I fully agree with that, but can you imagine yourself without any electricity or just certain hours in a day? No, you cannot. The only true measure that can have a real impact and enhance the climate action while we keep these caps is to massively invest in renewable energy and develop at a faster pace better and less energy consuming buildings, goods and services.

2.5. Legal issues of carbon credits/ international transferred mitigation outcomes

Without having an international carbon market system to which each country is subordinated and with the allowance of multilateral agreements between different local carbon markets, one important issue has arisen. The transfer of the carbon credit/ international transferred mitigation outcomes is an actual sales contract with a determined object- the allowance to pollute more than the actual credits given.

[11] Vladimir Spasic (2019). Romania mulls carbon price compensation scheme. Retrieved on June 14, 2019 from http://balkanrenewableenergynews.com/romania-mulls-carbon-price-compensation-scheme.

For trans-border sales contract to determine the law applicable in establishing the actual moment of transfer of property is a big problem and can cause a lot of harm because it creates space for double selling of the allowance which in the end leads to even more carbon dioxide emissions then the limits proposed. Without the establishment of a real international carbon market with a clear international legal frame and application mechanism, these kinds of conflicts are prawned to happen.

The possibility of a good faith acquisition is of importance for a transferee of an emissions allowance since ordinarily, a transferee cannot be sure whether the transferor's title to the allowance is free from any defects. In an international context, the question of good faith acquisition may arise in situations like the following hypothetical: An emissions allowance held in X's account in the registry of State A is stolen by Y through a "phishing attack[12]". After registration has been transferred to Y's account in the registry of State B, Y concludes a sale contract with Z, who is acting in good faith. Registration is then transferred from Y's account in the registry of State B to Z's account in the registry of State C. The laws of States A and B allow good faith acquisition of an emissions allowance upon the transfer of registration. Under the law of State C, however, a good faith acquisition is not allowed. What law is applicable to determine whether and under what conditions Z acquires good title to the allowance?[13]

Determining the nature of the allowance is crucial in determining the right legal solution to this conflict of laws. Carbon allowances/ credits are intangible goods.

These kinds of thefts have been have occurred in recent years in the EU Emissions Trading Scheme. Therefore, trading was brought to a halt as Europe's registries were closed to improve security measures[14].

To promote legal certainty, it is necessary to clarify the law applicable to the proprietary issues outlined in the preceding chapter. However, it is not sufficient for each constituent State to clarify individually the way in which it determines the applicable law, because if different constituent States of the same trading scheme determine the applicable law in different ways, the same allowance may be considered to be owned by different entities under the different laws which are applicable in different constituent States. To ensure the cohesive operation of a trading scheme, it is important to go one step further by unifying the determination of the applicable law among constituent States[15].

[12] Phishing is the fraudulent attempt to obtain sensitive information such as usernames, passwords and credit card details by disguising as a trustworthy entity in an electronic communication. Typically carried out by email spoofing or instant messaging, it often directs users to enter personal information at a fake website, the look and feel of which are identical to the legitimate site

[13] Koji Takahashi (2011). Conflicts of laws in emissions trading. P. 148. Yearbook of Private International Law, Volume 13, © Sellier; European law publishers & Swiss Institute of Comparative Law.

[14] The national registries of Germany, the Netherlands and Belgium were closed in November 2010. In January 2011, the national registries of all constituent States of the EU trading scheme were closed. It took about three months before all registries could resume operation.

[15] Koji Takahashi (2011). Conflicts of laws in emissions trading. P. 148. Yearbook of Private International Law, Volume 13, © Sellier; European law publishers & Swiss Institute of Comparative Law.

In the doctrine, different theories have been proposed, from applying the law of the issuing state to the one where the registration took place. A lot of authors support the last one, the law of the place where it was registered the allowance. An analogy with the proprietary issues of tangible movables seems to be preferred (lex loci rei sitae). Even if the carbon allowances are intangible goods, their place of registration can be considered the as a situs (fictional situs).

The rules of many countries are mostly the same. For example, if Y steals a painting and from X in State A and removes it to State B. While the painting is in State B, Y concludes a sale contract with Z, acting in good faith. Z then takes possession of the painting in State C. Whether and when Z acquires good title is determined by following the timeline. First is the moment when the sale contract is concluded. At that moment, the painting is situated in State B and, accordingly, the law of State B governs the requirements for good faith acquisition. If the law of State B requires the transferee to take possession of the painting, good faith acquisition does not occur at that moment. Second is the moment when Z takes possession of the painting. At that moment, the painting is situated in State C and, accordingly, the law of State C is applicable. If the requirements for good faith acquisition under that law are met, Z acquires good title. In this case and the one presented above with the carbon allowances the governance of the case will be established by applying the succession of the laws of state B and C. This being the case, the requirements under the law of state C are not met so Z does not acquire good title.

Is there a simple way to deal with all these successions of laws and serious complications that can appear related to the overflow of greenhouse gas emissions? Something that would make the transactions more efficient and secured from these types of attacks?

Let's take another example, company Z owns a registered emission allowance in state A and sells it to company Y in state B. Both states apply the same rule of law that the ownership of allowance is transferred at the moment of registration in the transferee's account (in our example company Y) in accordance with a valid sale contract. For state A to make amendments on the status of the allowance it is needed a notification from state B of the actual registration. But what if company Z resells the allowance before the notification arrives in state A to a third party, company X in state C and that company performs quicker the registration procedure and receives the notification of state C before state B? Who will be the owner is such a case? From the point of view of state A and state C it is clear that company X, which is acting in good faith; but for state B, company Y is the owner under the state law.

This is a complicated issue to determine and analyzing the timeframe of the events is important, but this is not the actual thing I want to highlight. These kinds of cases are existent for a long time, the problem is the lack of an international system of carbon trading; this can backfire in a very bad way and create an even bigger problem with the greenhouse gas emissions. From my point of view, this

case will take time to settle through courts and in the fight against climate change there isn't much time to wait. We need to think of an easier way to track down emissions allowances, their impact, and assure a secured way of transferring these allowances, while avoiding fishing or double selling. Is there an actual solution for this? It might be and it's named blockchain.

3. Blockchain

3.1. Notion

Blockchain is the latest development in the series of digital technologies that, due to their decentralized, horizontal, distributed and open source nature, are expected to cause fundamental and large-scale changes in how our current social, economic, political relations and institutions are organized.

Blockchain is designed to work as a trust machine.[16] In order to establish the trust between parties there are 3 elements needed: identity, ownership and verification. The importance of trust is crucial considering the number of frauds, double counting and double finance of projects that have happened in the climate finance sector and institutions.

It is a technology that relies on cryptography to maintain a continuously growing database of records, protecting all the registered information from being tampered with, even by their operators. It requires software that allows computers to communicate with each other directly through a distributed network of peers, where no one has special powers over the others. Thus, these databases are periodically updated with new information comprising new transactions or registries, and consensus is automatically reached, guaranteeing that everyone connected to the network sees the same information. In other words, each peer has the exact same copy of the database, with verified new information being added to it after passing through a decentralized validation process.[17]

First element is an established identity, which is set up by using digital signatures through asymmetric cryptography. Each user of the blockchain is given a set of two digital codes: a "public key," similar to an account number, and a "private key", like a password.

There are different methods to establish it, ranging from no guarantees to highly reassurance procedures. In the context of climate change, personally I support the need for at least substantial assurance of the identity of the user to avoid the wrong use of the blockchain applications. This would mostly require an accreditation by the Government.

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[16] K.N.C. (2019). The trust machine. Retrieved from https://www.economist.com/leaders/2015/10/31/the-trust-machine on 18th of April 2019.

[17] Leonardo Paz Neves, G.A. Prata (2018). Blockchain Contributions for the Climate Finance – Introducing a Debate report. p. 20. Published by Konrad Adenauer Stiftung.

The ownership of the database is the second very important element. Blockchain maintains a continuously growing database of records, protecting the whole transaction history of what is operating from being tampered with, even by their operators. In addition to the huge computational power that usually protects the database accounting the values each user possesses, there are also economic disincentives, making frauds financially pointless in most cases.

One last important element is verification. There are different blockchains created for different interests. A common interest sets up a network with a common database to which all parties can propose changes and the network itself will validate, rejecting fraudulent or wrong data from being recognized as valid and propagating only the proper information, periodically establishing consensus throughout the whole network. Everyone connected to the network sees the same information, as each peer has the exact same copy of the database, with verified new information being added to it. This public audit capability provides the system with an indisputably groundbreaking level of transparency.

"Proof of work" means that if you are a miner (a jargon for the users that connect to the network as a validating node), you need to offer a solution to a mathematical puzzle that demands a lot of computational power to be solved, in order to be able to add new information to the database that constitutes a Blockchain per se.

It is build up using cryptography which ensures another important aspect information, as well as its authenticity and authorship, is easy to verify, but it is practically impossible for a single entity or individual to elude it, as massive computational power would be needed and there are also considerable financial disincentives to do so.

The audit of the information is realized by the whole network of peers which gain immediate access to the activity that has been confirmed by the system's code and add their own copy to the blockchain. In this manner, this information has its validity publicly audited by everyone, according to the information itself, its author and the date and the time it was created.

A database built and generated by Blockchain technology can store data of any kind, it is possible to maintain a wide range of new services, much wider than those strictly monetary, with the same qualities of Bitcoin: inviolable, irreversible, secure, independent and decentralized.

There have been thought of numerous applications for this technology and one of them is actual the carbon market. Behind this idea lays the concept of smart contracts.

3.2. Smart contracts

In our modern times, a smart contract can be defined as a computer code that, upon the occurrence of a specified condition or conditions can run automatically according to pre-specified functions. The code can be stored and processed on a

distributed ledger and would write any resulting change into the distributed ledger[18].

Looking carefully to this definition the recognition that a smart contract is not necessarily a legal contract is important. As we can see, a smart contract is a program set up on an "if-then" statement condition.

When talking about smart legal contracts it is important to follow the elements needed to be qualified for now by the civil or commercial law as a contract: formation, modification and enforcement.

3.3. Legal aspects

In order to satisfy the elements of a contract, depending on the governing law of it one must verify that it meets all the conditions to form a legally binding contract. In the civil law system these are: capacity, consent, object and cause. The capacity to enter in such contracts has offered some diverged opinions because of the agents that act as representatives of companies and are in fact artificial intelligence programs. My personal view is if the legal frame of the country does not support such types of transactions the contract will be null and void for lacking one of the main elements. That doesn't mean that we need to keep it like that, on the contrary a rethinking of the capacity element extension is needed with the growing intelligent artificial market and development of new technologies.

The other elements of formation do not present much interest from the point of view of what legal impediments could the technology structure have as long as clearly the object of the agreement is the allowance of pollution, the cause is determined by the need of a company to have more carbon credits and be covered by the law for their extra emissions and the consent of each party is given in a legal manner.

The formation of the contract is very important, better said, the way the smart contract is coded will make a big difference. Extensive discussions about creating a common terminology to be implemented when coding the contract have been going on but without reaching the needed target. This can create a huge mess and offer space for bugs and hackers to tap into the contract.

The most famous incident to date was in the summer of 2016, when "THE DAO", a smart contract virtual company running on ETHEREUM platform, imploded after an exploitable bug had been found in the smart contract code. The DAO was an example of a Distributed Autonomous Organization, and, a virtual investment fund, that allowed participants to buy a stake, which would give them proportional voting rights on which future proposals should be funded. To the surprise –and perhaps even dismay of the initiators – The DAO managed to collect nearly $150M worth (at the time) of ether. However, shortly after the crowd-funding period, an attacker managed to gain control over a significant portion of

[18] Definition given by the Smart Contract Alliance.

the value in the fund (nearly $60M), due to a bug in the smart contract code. The resolution came in the form of a controversial, coordinated platform intervention that reverted the theft and dismantled the DAO. Some opposed this intervention, feeling it violated the "code-is-law" principle, and pushed for a fork of the platform[19].

The nature of blockchain, distributed ledger, smart legal contracts, and the parties thereto will inject complex issues into judicial proceedings. Such issues will likely include: Whether the court has personal jurisdiction over the parties to the contract (assuming those parties can be identified) or, alternatively, whether the court has jurisdiction over the assets at issue; whether the court has personal jurisdiction over the smart contract platform itself; whether the court has subject matter jurisdiction over the dispute, including consideration of whether and to what extent judicial enforcement is compatible with the "immutability" of distributed ledgers and public policy[20].

These are all aspects that can be fixed with the right set of laws. Most important aspect of the blockchain is that once a transaction is registered on the structure, it cannot be modified or tangled with and it even gives a stamp with the exact time of the transaction. To try to change the structure of the blockchain would require a lot of computational power and access to all the computers connected to the network. We can easily see that double counting of emissions and double selling of the emissions allowances becomes virtually impossible as long as the computer code of the smart contract is written well. Related to the issue of phishing, researchers are developing programs based on blockchain to be able to stop this phenomenon.

A company called MetaCert is trying to fight phishing emails with an extraordinarily simple method. The company has spent seven years compiling a database of web addresses known to be used by phishers, and the company and its users are constantly reporting more. Just as important, it also has a database of known "safe" addresses used by the companies, hackers like to spoof banks, payment services like PayPal, and online retailers. Meta Cert's software uses those databases to check the links in your email and place a little green shield next to known good links, a little red shield next to known phishing sites, and a gray shield next to unknown sites[21].

Conclusion

In my opinion, carbon markets have been created primarily by people with strong connections to financial institutions be those trading or even fossil fuel companies who saw an opportunity to make extra money. That does not mean that

[19] Maarten Everts, Frank Muller (2018). Will that smart contract really do what you expect it to do? P. 9. Report by TNO innovation for life.

[20] Prepared by Smart Contract Alliance at the initiative of the Chamber of Digital Commerce (2018). Smart contracts: Is the law ready? p. 30. Chamber of Digital Commerce.

[21] Klint Finley (2018). This company wants to use blockchain to stop phishing. Retrieved from https://www.wired.com/story/this-company-wants-blockchain-stop-phishing/ on 18th of April 2019.

the actual measure is completely negative. For the transition period to 100% clean energy societies it may be needed at least to set a cap for the greenhouse gas emissions. I don't believe companies should be allowed to buy as much as they can (or as many as available allowances are on the market) on the contrary; this method should stimulate more the innovation and faster passing to a sustainable development energy system. For this, it is needed a strict regulation, less cheating mechanisms as the ones from the Kyoto Protocol and a very clear protocol of how to apply these measures. Discussion has gone on about whether a local or global approach is needed in the formation of such markets and selling of such allowances.

The global carbon market is very fragmented. In the absence of a unified platform to purchase and sell carbon credits, regional markets have adopted different standards and policies. Trading costs are high because buyers and sellers rely on intermediaries to handle the often complex and cumbersome process.

I believe the best choice would be international approach and a common set of rules implemented on a blockchain. The blockchain could act simultaneously as a register and a trading platform for the carbon allowances that should be administered by the UNFCCC. In this way, the double counting, double selling and phishing could be solved if the smart contract is coded well. In our times such a desideratum is very difficult to obtain and from the way the Paris Agreement is drafted it is not considered as a first option. It is given but not enforced and the countries which fail to comply to reach their national determined contributions have no legal consequences, there are no means of a coercive mechanism, the creators of the agreement thinking that international shaming is enough to determine the countries to respect their promises.

Of course, the benefits of blockchain technology are unfortunately just theory, there isn't an actual practical case that has been implemented with carbon markets and this leaves us without effects to analyze, just possibilities. Slowly things are starting to change, and we may witness soon the results of a start up from Beijing.

In March 2019, the Beijing based company of environmental advocates named Synergy Blockchain Technology launched a carbon trading platform called VER. The company also launched its own carbon credit-backed cryptocurrency ECO_2, which is already trading on two cryptocurrency exchanges, to enable companies and individuals interested in purchasing and trading carbon credits to engage with more efficiency and transparency. To compare, the trading platform will be like the biggest e-commerce platform of China, Taobao, which is matching consumers to sellers, while the cryptocurrency will be used as a trading tool for payments and other transactions just like Alipay.

We can only wait and see if such projects will have a good impact, if it indeed represents a solution to the problems encountered till now in the carbon trading markets. One important element needs to be set, a rigorous legal structure of the carbon market, be that at a local or international level. Without that, any technologies we decide to use will not be effective. The setting up of the capacity of the market is crucial and this can only be done by the Government of each country considering its own national determined contribution and having in mind

the importance of stimulating a renewable energy market and not offering solutions for the big companies to cut out from developing more innovative and environmental friendly procedures. For this to happen it is needed a true commitment from all the governments (especially the big polluters as China, India, USA, Brazil, Indonesia, European Union, etc.) in setting as a top responsibility the enhancement of climate action. Till the moment the governments don't make the true commitment towards prioritizing the sustainable development of the world over just the economic development there is no hope for any solution to tackle the real big threat that climate change holds.

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BRÎNDUŞA MIHAELA RADU[1]

"NEW EDUCATION" AND THE KNOWLEDGE SOCIETY IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

Abstract. *Change in education is an objective necessity, determined by the transformations taking place in society - at a cultural, political, economic, community level, and these things must be reflected in the pedagogical plan. In spite of tensions and multiple conflicts, the priority objective of mankind is increasingly formulated in the notion of sustainable development.*

Education is trying to respond to the requirements of social development in two directions, that of educational content – which requires curriculum development by infusion, integration of new education and that of the philosophy of education – which concerns the orientation, sizing and rethinking of educational processes. The problems of the world in which we live: the crisis of the environment, globalization, poverty, unemployment, social failure, equality of chances, human rights, democracy have become problems of the education sciences, which have integrated them in what is called the new education.

The school is to be the center of change, a change of mentality first, an equally important aspect, but harder to solve than the economic change and reconstruction and the institutions of democracy. The new generation must not only be educated to adapt to the new, but also to anticipate change, to accept it and to actively participate in the process, thus contributing to the construction of the future. The specificity of our world is that it is changing faster and that it puts us in the face of original, unforeseeable and even unpredictable situations.

Key words: *New education, training, sustainable development, the knowledge society.*

Clasificare JEL : *I20, I21, I25.*

1. Introduction

Being aware of the problems and values of today's society, mankind knew how to formulate problem-solving strategies, coaching the values within which it is. The most important type of strategy is the one that realizes the change of mentality. And it is known that any change in mentality occurs effectively and globally through the transformative action of education, although it is not excluded that influence on the mentality exerted by economic, political, social realities, etc. Understanding in the most developed sense of this notion, education is omnipresent (so it affects economic, political, social, etc.), universal, imminent to any individual and social group, because it influences any change in economic, political and social change by changing the mentality of those which causes change in these areas.

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2. Education for change

The curriculum reform launched in 1977–1978 essentially seeks to radically change the conception of the role of the school: "The school was, in principle, the scene of a teaching-learning process, that is to say, assimilation of knowledge. It must become more and more the institution that assures a complete development of personality. The new programs will focus on individual study and the development of the originality of thinking; learning will be centered on fundamental concepts" [6].

Illustrative of this new way of understanding the school's purpose is the program of measures adopted in 1976 by the Ministry of Education, Science and Culture of Japan, where priority is not to increase the share of science and technology but to target:

- "Stimulating the students' ability to think independently and make the right decisions;
- A more pleasant and pleasant school life.
- Stimulating students' love for nature and for people, developing sociability.
- Cultivating love for the family, for the natal place conjoined with openness to the contemporary world "[8].

The curricular design promoted within the modern didactics is centered on the objectives of the instructive-educational activity, aiming at priority "optimizing the relations of pedagogical correspondence between the component elements (objectives – contents – methodology – evaluation), between the subordinate teaching and learning actions" [4] the fines at the system and process level. The development of curricular design involves a pedagogical approach oriented to three types of decisions (Seguin, 1991):

I. Macro-structural decisions of a philosophical and political nature involving the setting of both the fundamental options (the pedagogical ideal, the goals) that define the evolutions of the system and the pedagogical resources (human, informational, etc.) necessary for the educational system as a whole;

II. Depending on (I) pedagogical macro-pedagogical decisions involving three elements: establishing the criteria for elaborating educational plans, establishing the profiles of training / development of the personality of the pupil / student on the different stages of his / her formation, establishing the modalities the overall and partial evaluation of their level of training;

III. Micro-structural decisions that also involve: setting specific objectives on educational subjects or modules, establishing the pedagogical resources needed to achieve the specific objectives, establishing the modalities of partial evaluation of pupils / students.

Curricular design does not exclude but instead relies on the three ways of conceiving student / student teacher correlation at the three levels: frontal, group, individual but should focus more on the individual level. Under the current conditions, individual learning "evolves from the extreme, socially inappropriate

solution ("each teacher works with a student in his own rhythm") to curricular inspirational processes integrated into different front-to-school or group teaching strategies: individual work, homework themes, learning tasks (play, work or creation) practiced in the class but also in the school or extra school environment "[12].

The philosophical basis of the modular structure of education is holism (from holus = whole, totally) "attempt to conceive an informational totality as an integrated unit of elements that lose their sequential traits" [13].

Modular structure facilitates the inclusion of special knowledge in logical assemblies that exceed quantitatively and qualitatively the characteristics of the curricular divisions. Students / students are provided with modular chains or suites depending on their instructional or educational objectives or their interests and skills. Modules can be different in terms of difficulty, level and pace of work. The pupil / student choose or propose to follow a (or more) way that he goes through with the teacher's support, then evaluating the results. In case of failure, it is recommended to go through a lower or complementary module.

Modular learning cannot be fully expanded. As a rule, basic subjects are taught in a mono disciplinary perspective. Modular dimensioning of content "is done for a group of disciplines (this does not mean that the modules overlap over the classical learning objects, but they are novel syntheses, new epistemic perspectives, integrated knowledge accumulations, etc.) that follow differences even for the professional orientation of students" [6].

From the presentation made in the first part of this study, the educational phenomenon is subjected at all levels (conceptual, content, approaches, at structural, systemic, methodological level etc.) to changes of either "natural" or provoked, directed, planned.

The second part of the study is devoted to education for change.

In a world like ours, subjected to permanent, faster or slower, sharper, or more discrete changes to "stepping on", to delay or even to resist going before are harmful or even dangerous behaviors to the contemporary man generally for the school man in particular. Stagnation means condemnation to poverty (material, spiritual), to misery (material, moral) to death, ultimately.

In the field we refer to "education for change should be the pivot around which to change education" [7]. That is why school should be a central place for change, change of mentality first – at least as important (as the hardest to solve) as the economic change and reconstruction and the institutions of democracy.

At the moment, the Central and East European countries are in front of them (some have gone on this road and go faster than others) to changes that are thought to be profound, complete and radical. They want to recover the half-century-long delay that separates them from Western Europe. These societies are going through the reverse, from totalitarian systems to democratic societies, and no one - scientists, politicians or economists – "seem to know the best way, but it is clear that whatever path we choose, it must go through changing mentalities (sub-MM), so changing the school "[9]. The signal for moving to the conception of education

for change was given in 1926 by W.H. Kilpatrick but he was heard much later, after World War II and especially over the past 15–20 years. It is Gaston Berger who (after 1950) puts the issue of education for a changing world in a more optimistic position, promoting the thesis that the future can be predicted in its great evolutionary lines as it can be projected within certain limits and, consequently, we need to work towards developing an education system designed from the perspective of this future.

The young generation must not be educated just to adapt to the new, but to help build the future. "The specific of our world is that it is changing faster and that it puts us in the face of original, unforeseeable and even unpredictable situations" [9] – wrote G. Bergev. For this reason, the main task in the formation of man must not be both instruction and education, namely education that provides the educator with an open behavior towards change and an attitude that favors the use of innovative behavior techniques.

New education, emerging from real needs – education for change, ecological education, modern domestic economic education, etc. are nothing but attempts "to prepare the individual and the communities to solve this complex problem faced by humanity in its entirety" [6].

Life, the experience of modern man, shows that learning to maintain, simply reproducing the values of the past, tradition are not enough to "equip" the man of the future society. The old type of learning, based on a "learning" learning, can no longer satisfy today when the changes are so rapid and complex, causing real "shocks" to the contemporary man.

There is therefore a need for another education, namely "one that can bring about change, reunion, restructuring, and problem reformulation - which we will call innovative learning" [17].

This innovative learning as an essential element of education for change is "a necessary means to prepare both individuals and societies to act concertedly in new situations, especially in situations that have been and continue to be created by mankind itself" [12].

Particularly distinct from traditional learning, the new form of learning is anticipatory, that is to say, in coherence with a vision in which the future is not only expected or welcomed, but also designed and constructed according to a set of desirable objectives in order to avoid undesirable effects. Also, this type of learning is the characteristic and the participatory dimension, thus creating two types of solidarity essential to the survival of the human species: time (through anticipation) and space (by participation).

There are three major directions in which to work in education for change:

a) reporting and meeting changes;

b) their evaluation;

c) the design of change and intervention (control of change) all three aiming at the formation of man so that he can cope with the changes to his environment.

Particularly interested in aspect (c). It is not enough for the man of today to only notice, to meet and to evaluate the changes that occur in one area or another of society. As a subject of history, a participant in social processes (not a spectator!), He must design changes himself, intervene in their flow to provoke the desired effects, limit or avoid the undesirable ones. That is why he needs to be educated in the spirit of alternative solutions, in the scenarios of possible future prospects. Intervention for change implies, to a certain extent, the planning of change (limited and precise goals, realistic goals and deadlines).

As far as the means of education for change are concerned, they stimulate anticipatory imagination, choice and initiative, responsibility, using all the resources and processes that create "images of the future", "alternative scenarios", "possible world models" "Multiple solution issues" etc.

In front of such a desirable behavior of contemporary man, education must give an adequate, appropriate, response. He should give up on discipline and move on to focus on complex issues, to become an inter-and trans-disciplinary education. He must, among other things, adopt such a strategy that allows the gradual introduction of new education within its "classical" structure.

Different contemplations of the contemporary world were answered with specific education. The achieved theoretical advances are important, but new content is still slowly entering the school structured (yet) on disciplines, in the form of program plans. Progress is unequal (or even absent) when it comes to introducing curricular and modular approaches. It has made demographic, nutritional and ecological education easier.

A notable weight in the development of these new educations also comes from the fact that there are difficulties regarding the training of educators (teachers) able to teach in modular fashion or groupings of interdisciplinary or transdisciplinary content.

3. New Education

New Education – is the approach of today's education society, a suite of strategies and general objectives responding to the imperatives indicated by the problems of today's society, and not educational concepts or theories about educational content [4]. New education stems from the types of education that have traditionally been formed: intellectual education, moral education, aesthetic education, religious education, etc. The new education is marked by the imperative and priority fields of up-to-date education, but their nomenclature does not exhaust the priorities of contemporary education, but it complements them. UNESCO, through the strategies formulated, draws the attention of the world public opinion to some untapped potential for solving the problems of the current society. In this context, G. Văideanu in the Millennium Border Education project refers to certain objectives [12]:

- Environmental education or environmental education;
- Education for Change and Development;
- Education for technology and progress;
- Education towards the media;
- Education in population or demographic;
- Education for Peace and Cooperation;
- Education for Democracy;
- Modern health education.

Effective compatibility of the education systems of the European states would involve a set of activities in each country that accepts the European idea, designed for the correlated realization of all the educational objectives indicated by the term "new education" with the national educational objectives, by a European idea, the concept of economic, social, technical-scientific, cultural and spiritual unity of the peoples living in the European space, each nation retaining its specific identity and color or the unification of Europe, the European integration – the term of Al. Husar [21].

Since 2000, the European Commission has adopted a series of recommendations on the promotion in each European country of an education that includes not only structural, but also educational, coincidence elements. In social reality, however, violence, racism, religious, ethnic and cultural intolerance increase. In response to these phenomena, UNESCO is developing a new educational model, called the new education, which aims to create, on unique principles, a unique pedagogical society and a unique educational environment. The proposed model develops on two complementary concepts: the classical concept centered on objectivity, which is the axis of the rationality of education, and the modern concept, focused on the balance between the subjective and objective, which represents the axis of integrating the differences in the concrete pedagogical actions considered as the educational standard of the world modern.

New education should not be seen only as a source of renewal and reconstruction of content that derives from the traditional dimensions of education. It is the merit of the Romanian school about the preoccupations for the issues of new education, which coincided with the concerns of the Western world. More than 25 years ago Professor George Văideanu and collaborators used the term and described new education. But the meritorious precedents should be cited: The University of Bucharest is among the top 10 universities in the world, who have created computing centers 5 decades ago, thanks to academician Gr. C. Moisil [20].

In a super-technologized society, we should look at new education not as isolated dimensions but in their multiple systemic relationships and from the perspective of the future effect [19]. The ability to master modern technologies from an intellectual, political and social point of view is one of the major challenges of modern man in this century.

The new education, in order of their appearance, would be:

- Environmental education (or ecological education);
- Population education (or demographic education);
- Nutritional Education; Education for new technology and progress;
- Education towards the media;
- Education for Peace and Cooperation;
- Education for Democracy and Human Rights;
- Modern health education;
- Modern economic and modern education;
- Education for leisure;
- Education for a new international order;
- Education with international vocation;
- Education for a quality life;
- Intercultural education, etc.

This list will remain open, and may be completed at any time.

These precepts obviously enrich the axiological content of education, making it more dynamic and at the same time orient the sense of education from the classical multidisciplinary model to the interdisciplinary model. One of the new education is also considered the education for freedom [1], whose general significance is defined as the synthesis and finality of all new and traditional education, for human freedom should not be understood only in a political sense, but especially in a spiritual sense, and this is only possible through a complex education that articulates all types of education.

a) Environmental education or environmental education is the field of education responsible for the formation of environmental consciousness or environmental consciousness, understood as an existential environment – geographic, natural, cultural – the awareness of the primacy of the environment in relation to the individual and his / her organic belonging to the environment.
b) Education for change and development has the goal of forming homo faber (literally the man who does it). Congenitally devoted to forming the ability to make an option, man becomes a subject of change and development of both the outer existential universe and his intimate universe. The action of change is also congenital. But any prerequisite to becoming an entity only gets status as a factor of change and development through education and self-education.
c) Education for technology and progress shapes man's ability to technology and activity in various fields. It is the type of education that answers the question of how to become one. The second term indicates the quality of change: progressive. In the daily, however, this type of education is understood at the surface level: education for the acquisition of modern technologies for the production of material values and for technical, economic, scientific progress.

d) Media education is the first type of really new education, because the mass media has become massive in social life only in the X^{on} century, today their role in society is extremely large, that they have been called the fourth power in the state. However, the use of its products requires special training, which is not limited to reading newspapers, listening to radio and watching TV shows. Media education involves knowing the language of publicity, TV shows and Internet portals, which is particularly sophisticated, as well as the action they have on the formation, development of human personality.

e) Population or demographic education implies the ability to regulate natality, geographic distribution, population structure and density, composition of age and gender, etc.

f) Education for Peace and Co-operation subscribes to the concept of peaceful cohabitation of people and peoples. It is, in fact, a desideratum of a moral nature, because until now the role of wars has not yet been demonstrated in the history of mankind, as the possibility of peaceful coexistence has not been demonstrated either.

g) Education for Democracy, although it has its roots in the Greek antiquity, is one of the new types of education, X^{on} century mankind has reached a degree of development conducive to the establishment of a democratic society. The essence of education for democracy is in forming democratic consciousness and the ability to attain attitudes and behaviors that allow each one to manifest himself as fully as possible in his self-fulfilling without harm to others. Democracy is not a given, the modern man is responsible for his formation as a being with democratic consciousness and the only real force that can build a democratic society. In turn, democratic society has a positive influence on the formation of democratic consciousness.

h) Modern health education consists of the formation of knowledge and abilities for proper body care and the creation of a healthy environment and way of life. New education is not only a response given by educational policies to the great problems of today's society, but also an extremely important value in the cultural-spiritual unification of the modern world, a fundamental aspect of the globalization process.

4. Design approaches to the content of school disciplines through new education

New education can be adapted to the context of each dimension of the formation of the personality culture bases (for example, ecological education can be addressed in the context of moral education programs and economic education issues can be examined from the perspective of ecological education) [18].

In the literature some possibilities of introduction of “new education” are mentioned in the curricula.

1. Disciplinary approach – addressing new education within distinct school disciplines (for example, environmental education appears as an integrated school subject in the curriculum, with institutionalized objectives at the level of school curricula).
2. Modular approach – creating specific modules within traditional disciplines with an interdisciplinary character, approaching new education within school curricula, integrated at different levels of education, but also in the dimensions of education (for example, environmental education addressed as a way of biology, in high school education, with specific objectives of the dimension of intellectual education).
3. Infusional approach – integrating the messages about new education into traditional subjects, approaching the issues of new education in school subjects (e.g. the issue of ecological education is approached simultaneously in biology, chemistry, geography, physics, etc., but also at level of education: intellectual-moral-technological-sanitary, etc.).
4. Transdisciplinary approach – approaching new education at the level of scientific summaries proposed annually or quarterly / semester by teams of teachers (e.g. addressing the global issues of ecological education from the perspective of a team of biology, chemistry, physics, geography, economics, sociology, philosophy, etc., in the framework of synthetic lessons, ethical seminars, thematic debates, school competitions, etc.

In the countries of Europe, a series of projects have been carried out and are still being carried out in order to promote new education, which are effective strategies for implementing types of education adapted to the current society.

5. Conclusions

Besides some traditional techniques that maintain themselves because they are good and others that persist because of a devious routine, modern school offers a different look in some aspects than in the past. We are witnessing a complex movement of extraordinary magnitude, too strong to to be a treacherous fashion. What we are expressing through the expressions "active school", "new schools", "progressive education", shows this movement globally. They are names more suggestive than descriptive, evoking not only general aspects of the educational technique but expressions and certain pedagogical principles.

The "new education" movement begins practically at the end of the last century, which shows that the adjective "we" is not fully justified.

New education is new objectives and new types of content generated by "contemporary world issues". They correspond to childcare needs being integrative and cumulative. They also appear to be the most pertinent and most useful answer of the educational systems generated by the problems the contemporary world.

Permanent education – education begins with the birth of the human being and becomes an alignment of its existence throughout its life: "it involves a

complex, cohesive and integrated system, offering its own means to respond to the educational and cultural aspirations of each individual, its faculties, it is designed to enable everyone to develop their personality throughout their life by appointing them or their activities"

If some of the new education is well-rounded, others are being discussed in order to clarify and delimit them; however, addressing new education or new content remains an open issue.

New education is still a matter open to their specification and delimitation, to the establishment of the implementation methodology. At present, specialists in the field highlight the fact that they are capitalized and have profound implications in the five dimensions of the personality training and development process, which means that the education approaches as an intellectual, moral, aesthetic, technological and physical approach.

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ALEXANDRU COLESNICOV[1]
LUDMILA MALAHOV[2]

USING SECOND GENERATION WIKI-PLATFORM IN THE DEVELOPMENT OF ONLINE ECONOMIC APPLICATIONS[3]

Abstract. *Concept of Web 2.0, also "Participatory Web" or "Social Web", is known since 2004. The main characteristics of Web 2.0 are wide participation of users in creation of the site content, and great interoperability, i.e., compatibility with other systems. The work discusses the essential aspects of implementation of online economic applications under XWiki. XWiki is a second generation Wiki system with all main features from Web 2.0. We take as an example an application that provides online audit and econometric calculations over the user's data on a specific enterprise (micro-economic analysis of gender equality on labour market). Calculations include data grouping, statistics, extended Mincer's equation, Duncan index of dissimilarity, the Oaxaca-Blinder decomposition.*

Key words: *online economic applications, Wiki system, online audit, econometric calculations, gender equality on labour market.*

JEL: *C02, C80, C88, C89*

1. Introduction: what is Web 2.0?

Concept of Web 2.0 is informal. It is the next stage of development of the Internet. Its main characteristics are replacement of static Web pages by pages with dynamic or user-generated content, and quick growth of social media. More detailed descriptions include also ease of use, participatory culture and interoperability for end users. Therefore, terms "Social Web" or "Participatory Web" are applied.

The term "Web 2.0" is known since 1999 and became popular since 2004.

Existence of Web 2.0 doesn't imply that all pages in World Wide Web are of the second generation. A lot of old-fashioned static pages continue to live and are developed anew.

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[3] *This paper was elaborated in the framework of the scientific project for the years 2018–2020, entered in the State Register of Science and Innovation Projects with the code 18.80013.0807.06.STCU / 6336 "Innovative approaches to applied computations and software development for gender equality regulation on labor market" („Abordări novaționale privind dezvoltarea calculelor aplicative și software-ului pentru reglementarea egalității de gen pe piața forței de muncă"), within the framework of the STCU-ASM Joint Research-Development Initiatives Program, the call from 10.04.2017.*

In fact, Web 2.0 cover more than Web pages; it reorganizes the whole paradigm and approaches to network interaction.

Let us take a task of file hosting as an example. Web 1.0 solutions like Akamai[4] or Letitbit[5] are widely known and used. Web 2.0 replacement for file hosting is *torrent*, where endusers distribute stored files directly from their computers without intermediary host and formal procedures, and even don't use fixed connection. In torrent, files are transferred by chunks of standard length; any chunk can be taken from any computer that keeps this chunk. It is possible that a computer gets chunks of a file and distributes in parallel other chunks of the same file, which this computer obtained before. The whole process is regulated automatically. Modern conception of cloud seems to be further development of Web 1.0 file hosting that can be positioned in between of old variant with its formality and regulation, and the anarchy of torrent.

Interoperability means great compatibility with other systems. This is another important characteristic of Web 2.0 as it plays the main role in the subject of this paper.

2. The developed software

We develop a Web application that helps companies and enterprises to estimate gender misbalance at the company employees, and helps specialists to provide recommendation on equalizing this misbalance, with possible generalization to the whole labour market.

The application supposes four types of users: visitors (guests), clients, specialists, and system administrators.

Visitor's access rights are restricted by main page and several pages with documentation. Visitor is not registered. He cant't start calculations but can see examples of those or video clips. To use other possibilities, visitor can apply for registration.

Client is a registered user that can present data of his company, perform calculations and get recommendations of specialists. His access rights cover additional pages where he stores his data, starts calculations, get results and recommendations, and discusses them. Each client works on separate pages because his presented data are kept as strictly confidential and can't be accessed by another client.

Specialist is a registered user that has access to data of all clients or of a group of clients, and to results of calculations. His task is economic analysis of clients' results and development of recommendations. A specialist can use client's data, for example, for his own scientific work, but only if it is explicitly permitted by the client. The client can put restrictions on usage of his data, for example "only generalized (total and subtotal) indices".

System administrator has full access to the whole application and data and perform support of its work.

[4] https://www.akamai.com/
[5] http://wm.letitbit.net/

3. Client's working session

Client can present data in several formats including CSV and Excel worksheet.

The data should contain indicators of all employees of the company or its subdivision for a year. The indicators are: gender, age, position at the company, level of education, working experience (in general, and at the company), marital status, number of children, sum of all payments, number of days for business trips, trainings, and illness, type of working conditions, etc. These data are necessary to estimate local gender misbalance of labour force.

For data, the second level of confidentiality is supported. The data should not contain any real personal information like name, SSN or passport number. Employee's string in the data table should be identified by a depersonalized code that exists only for these data and should not be induced from any personal data. We are not interested in personalizing the data because all calculations produce more or less generalized results, and only they will be used in research. Nevertheless, client can restrict usage of his data and results. Raw (source) client's data couldn't be transmitted to any third part in any case.

After the data are entered, the system verifies them and ask corrections if necessary.

Each data item should be validated individually. Additionally, there are dependencies between data items that can be used for their validation. As a general rule, all individual data verification is performed before their validation by dependencies.

Moreover, some data may be not presented. We differ mandatory and optional data. In some cases a lost item may be replaced by a default value.

We also differ determined and fuzzy dependencies.

At the moment we use 25 parameters collected in user's data tables, and three additional parameters listed below:

a_{min} – minimal age of labour permitted by the law, for example, a_{min}=14

a_{max} – estimated maximal age, for example, a_{max}=150

a_{ad} – adult age by the law, for example, a_{ad}=18

Data verification module validates data applying the following algorithm.

1. Values to additional parameters depending on the country are set.
2. Presence of mandatory parameters is checked, and lost values are filled in by default values.
3. Individual validation of each parameter is performed, including data type correspondence.
4. Determined dependencies are checked.
5. Fuzzy dependencies are checked.
6. If a value is found invalid, the message is issued, and the check continues.

As the data seem to be correct, the client initializes prescribed calculations. Calculations include 16 algorithms that are divided in several groups.

A. Statistical analysis of some parameter from input data in general and by gender, in numbers and percent rates. There are 11 calculations of the kind, for:

gender distribution; level of education; age groups; marital status; number of children; work experience, total and in the area; work arrangements; territorial distribution (if applied); dismissals in total and by dismissal cause; illness, business trips, and trainings.

B. Analysis of salary distribution by gender, in percent rates.
C. Complex analyze of types of activity in general and by gender, also with additional grouping by salary, education, experience and working arrangements, plus average age and number of children, and marital status (%), in numbers and percent rates.
D. Mincer regression, with logarithm of monthly salary as the dependent variable.
E. Blinder-Oaxaca decomposition of gender difference in wages (salary) into explained and unexplained parts.
F. Duncan index of vertical segregation by gender.

The client gets and stores results of calculations. Results are shown in absolute quantities and in percent, and presented as tables and graphics (diagrams).Pandas library of Data Analysis exports data from Python DataFrame object in several formats, including HTML table, CSV (Comma-Separated Values), Excel spreadsheet, etc. HTML output is directly inserted into the XWiki dynamic HTML page.

For graphic presentation, in addition to XWiki extensions, we used the Python 3 library Matplotlib.

Specialists analyze these results and contact the client for discussion and recommendations.

This cycle may be repeated with slightly corrected data, or data for another year, or data for another subdivision of the company. Client is provided by the necessary space (pages) to store his data and results, and he can revise them as necessary, or copy for his own use.

4. Implementation of the software in the Web 2.0 environment

The gender audit platform is divided into 4 main functional modules: data import module, data verification module, data processing module, and results presentation module.

For programming, the XWiki[6] environment is used. Motivation for this selection was published in [1].

Additionally, more convenient toolsto program complex economic calculations are used, namely, Python 3 [2,3] with the Pandas [4,5] library (Python Data Analysis) and other necessary modules. The ability to use the necessary additional development tools is one of the power features of the Web 2.0 approach implemented in the XWiki environment.

The XWiki environment offers a number of extensions, some of which we use. However, this functionality is not always enough to implement the challenges.

[6] https://www.xwiki.org/xwiki/bin/view/Main/WebHome

The XWiki environment provides, as an extension, a macro to include a Python program directly in the code of a dynamic Web page. We tried this extension and found out that its functionality is not complete. Namely, the specified extension is implemented using Jython libraries that implement Python in the Java environment. With this approach, translation from the Python language is performed not into the Python interpreter codes, but into the codes of the Java virtual machine.Their execution is performed in the Java environment. Two restrictions follow from this: on the version of the language and on plug-in library technologies.

Jython implements an older version of Python 2, version 2.7, on which development of Python 2 was stopped. All innovations from Python 3 are thus unavailable.

In addition, only those Python libraries that use only the binary code of the Python interpreter, which can be easily translated into Java virtual machine code, can be transferred under Jython. However, most modern Python libraries make extensive use of machine code for optimization purposes. Such libraries, in principle, cannot be connected withJython. Unfortunately, this concerns just the most needed libraries that implement complex calculations, for example, the least squares method. These include the NumPy, SciPy, Pandas libraries and several others. Finally, from July 2019, support of the Pandas library for Python 2 has been discontinued.

The flexibility of the Web 2.0 approach helped us in that case as well. The simplest calculations in Python 2 were included directly in the code of the dynamic page. For more complex calculations (regression analysis, etc.), a slightly more complex workaround was used. In the future, it is possible to implement this method as a new XWiki extension. Being a Web 2.0 environment, XWiki welcomes user extensions, but we have not set this goal yet.

In our case, we used the most modern standard implementation of Python 3, namely, CPythonthat is based on C. This implementation has access to a full set of libraries, loaded from the PyPy repository at necessity, and an update tool. This implementation must be specially installed on the XWiki server both under Linux (our case) and under Windows.

At the same time, we got the opportunity to debug Python programs independently outside of the XWiki environment, including in specialized shells, and even on other machines, which we widely used. All that was needed was to ensure that all machines on the developers and the XWiki server had the same set of Python libraries installed.

Next, the JPserve library was installed.It is an implementation of Python calling tools from a Java program. This library consists of a server written in Python and a client implemented in Java. Being a Python module, the server part is installed in the usual way: with the *pip* command from the PyPy repository. The client library is added (copied) to the root directory of the Tomcat Web application server along with other Java archives that collectively implement the XWiki environment, and thus become part of XWiki.

You can’t use the root user to start the Python server for security reasons. For this purpose, a separate user was specially created, in whose partition the server is started and all calculations are performed, and all Python programs and intermediate data, if any, are stored. Using a dedicated user makes it impossible to damage from Python 3

areas belonging to other Linux users in the case of a possible developer error. During development, we started the Python server manually in the background, leaving it working until the system reboot. In the future, this process is subject to automation.

To run the economic computing program in Python and include the result of the calculations in a dynamic XWiki page, the Groovy macro is included in the code of this page. Groovy is an extension for Java. In fact, in this way Java code is included in the page. In this case, everything displayed by the *print()* or *println()* commands is considered the XWiki code (extended HTML) and displayed by the browser. It is very important that there can be several such fragments in different programming languages on a page, and all of them use a common pool of variables.

In the Groovy code, a client program is called, one of the parameters of which is the name of the Python program to be executed. The Java client (that is, XWiki) sends a request to execute the program on the port allocated for this purpose to the server. A previously running Python server accepts the request and runs the specified program. The result must be assigned to the variable *_result_* and returned to the client (in the Java program) in standard JSON encoding. Turning a JSON string into XWiki variable values or into HTML code will be performed by a standard program available from Java.

We used the same machine as a client (XWiki) and as a server (Python), although these may be different machines. The port is set when the Python server starts (by default *8888*), and the Python server URL is set when the client requests it (by default *localhost*).

5. Conclusion

In our case, software development in Web 2.0 environment was extremely comfortable, mainly because of its great interoperability/ This permitted us to use powerful Python 3 libraries to implement necessary algorithms. The difficulty level of this implementation is comparable with direct calculations in Excel or other econometrical application.

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EXPERIENCE IMPLEMENTING SOCIAL INVESTMENT PROJECTS SUPPORTED BY THE WORLD BANK

Abstract. *The World Bank is an international financial organization established to provide financial and technical assistance to developing or low-income countries. The organization aims to promote sustainable globalization in the interests of all segments of the population, reduce poverty, accelerate economic growth without harming the environment, and create new opportunities for people to live fulfilling lives.*

Throughout its history, the World Bank has been a fairly serious investor in the economies of developing countries, financially supporting a wide range of industries and programs. The Bank focuses on poverty, food supply, agriculture, health, education, environmental problems, and other initiatives.

Despite certain successes achieved by the Bank in the implementation of its social programs and projects, its activities are often criticized as ineffective or aimed at supporting countries that do not really need this support. In addition, the World Bank exerts enormous influence over the economies of developing countries through loan conditions, advisory services, technical assistance and policy blueprints, which have similarly been criticized by civil society, academics, and developing country governments.

Since the early 2000s, Moldova, the poorest country in Europe, has made significant progress in achieving inclusive growth, averaging 5% annually and reducing poverty from 26% in 2007 to 11% in 2014. During the 26 years of cooperation between the World Bank and the Republic of Moldova, a number of projects in the social-economic fields were launched and successfully implemented, which brought Moldova to a completely different level of development.

Key words: *International Bank for Reconstruction and Development, International Development Association, social investment projects, sustanable development, World Bank.*

JEL: *A130, Z130*

The World Bank – is an international financial institution that provides loans and grants to the governments of poorer countries for the purpose of pursuing capital projects. It comprises two institutions: the International Bank for Reconstruction and Development (IBRD), and the International Development Association (IDA). The World Bank is a component of the World Bank Group [19].

The World Bank Group is composed of the following institutions: the IBRD (1944), the International Finance Corporation (1956), the IDA (1960), the International Centre for Settlement of Investment Disputes (1966) and the Multilateral Investment Guarantee Agency (1988). The IBRD gives technical and financial assistance to

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medium-income countries and credit-worthy countries, and the IDA supplies interest-free credits and grants to the poorest countries. The IFC acts exclusively with the private sector and has a different structure, staff and norms from that of the IBRD and the IDA. The ICSID arbitrates disputes between foreign capital and governments, while MIGA fosters foreign direct investments and insures them against the risks of natural disasters and conflicts [8].

The World Bank came into existence in 1944 at the Bretton Woods conference. The World Bank's first loans were extended during the late 1940s to finance the reconstruction of the war-ravaged economies of Western Europe. When these nations recovered some measure of economic self-sufficiency, the World Bank turned its attention to assisting the world's poorer nations. The World Bank has one central purpose: to promote economic and social progress in developing countries by helping raise productivity so that their people may live a better and fuller life [6]. As of November 2018, the largest recipients of World Bank loans were India ($859 million in 2018) and China ($370 million in 2018), through loans from IBRD [19].

The World Bank's most recent stated goal is the reduction of poverty [19]. Poverty and shared prosperity presents indicators that measure progress toward the World Bank Group's twin goals of ending extreme poverty by 2030 and promoting shared prosperity in every country in a sustainable manner. These two goals are closely linked to key themes of the Sustainable Development Goals: Goal 1 seeks to end poverty in all its forms everywhere, and Goal 10 focuses on reducing inequality within and across countries [11].

The first of the World Bank's goals aims to reduce the share of people worldwide living below the international poverty line[2] to below 3 percent by 2030. The related Sustainable Development Goal target is even more ambitious: it aims for all countries, regions, and groups within countries to achieve zero poverty at the same international poverty line [11].

The current primary focus of the World Bank centers on six strategic themes [1]:

Poverty reduction and sustainable growth in the poorest countries, especially in Africa.

Solutions to the special challenges of postconflict countries and fragile states.

Development solutions with customized services as well as financing for middle-income countries.

Addressing regional and global issues that cross national borders, such as climate change, infectious diseases, and trade. Greater development and opportunity in the Arab world. Leveraging the best global knowledge to support development. The Bank strategy and its goals are realizing through the different developing

[2] Since 2008, the last update of the global poverty line, the Bank has used $1.25 as the global line. As of October 2015, the new global poverty line is set at $1.90 using 2011 prices. Just over 900 million people globally lived under this line in 2012. [https://www.worldbank.org/en/topic/poverty/brief/global-poverty-line-faq]

programs implemented by the IDA and the IBRD, which promote practically the same goals.

The International Bank for Reconstruction and Development was created in 1944 to help Europe rebuild after World War II. As the largest development bank in the world, it supports the World Bank Group's mission by providing loans, guarantees, risk management products, and advisory services to middle-income and creditworthy low-income countries, as well as by coordinating responses to regional and global challenges.IBRD is owned by the governments of its 189 member countries.Moldova joined IBRD on August 12, 1992, which is considered the official date of membership in the World Bank [17; 18, p. 7].

The International Development Association (IDA) is the part of the World Bank that helps the world's poorest countries. Established in 1960, IDA aims to reduce poverty by providing loans (called "credits") and grants for programs that boost economic growth, reduce inequalities, and improve people's living conditions. IDA is one of the largest sources of assistance for the world's 77 poorest countries, 39 of which are in Africa. Moldova joined IDA on June 14, 1994 [5, p. 3;18 p. 7].

Across all fiscal years (1993–2019) of collaboration between the Republic of Moldova and the IBRD/IDA, Moldova has received a total of $1,469.86 mil. in grants, credits, and loans for the implementation of over 50 projects designated toward various socioeconomic problems (Chart 1).

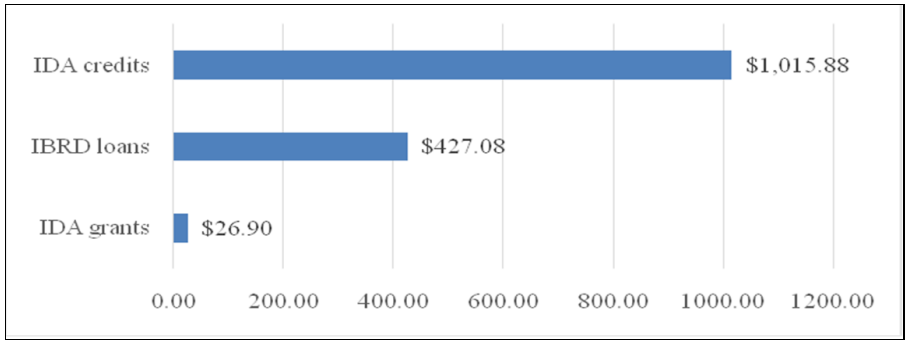

Chart 1. IBRD/IDA lending across FY1993-FY2019, in millions USD[3]

IBRD/IDA funded projects are apportioned into the following themes: rural services and infrastructure – 15%, climate change – 13%, regulation and competition policy – 13%, administration and civil service reform – 9%, education for all – 9%, rural services and institutions – 9%, rural markets – 9%, micro, small and medium enterprise support – 8%, public expenditure, financial management and procurement – 8%, state-owned enterprises restructure and privatization – 8% (Chart 2).

[3] Data source: https://financesapp.worldbank.org/

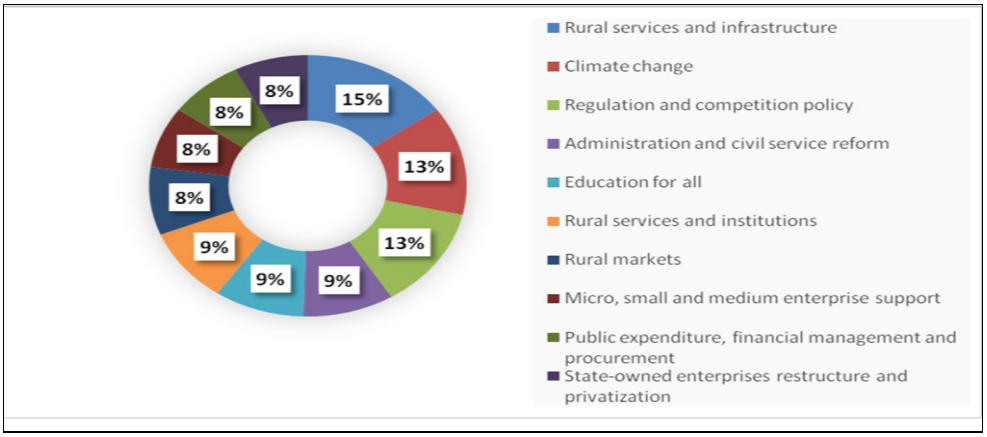

Chart 2. Distribution of implemented IBRD/IDA projects
by theme across FY1993-FY2019[4]

During the 26 years of cooperation, developmental efforts to boost prosperity have targeted a broad range of initiatives, covering areas such as health, education, agriculture, energy, water supply and sanitation, e-governance, social protection, competitiveness, and many others. Over $1,600m have been committed in support of about 100 projects. Over 340 trust funds have been implemented in excess of $200m. The IFC and the MIGA, two members of the World Bank Group, provided finance and guarantees for a total of $295m. [7; 17 p. 3].

The World Bank defines Moldova as a small, lower-middle-income economy. Moldova has experienced rapid economic growth in the past decade, accompanied by significant progress in poverty reduction and shared prosperity. The economy has been growing at 5% annually since the 2000s, driven by consumption and fueled by remittances. At the same time, the national poverty rate dropped from 68% to 27% between 2000 and 2004 and continued the downward trend to 9.6% in 2015. The percentage of those living on less than $1.90 a day has dropped from 39.1% in 1999 to zero. At its peak, the poverty rate for those living on $5 a day was at 90.4% in the year 2000. It has since dropped to 16.3% [12; 15; 13, p.10].

The gap between absolute urban and rural poverty is significant – 19% of population living at the poverty line in rural areas vs. 5% in urban areas. The poorest spend the largest share of income on food and utilities, which makes them vulnerable to economic shocks [14]. Remittances and pensions are responsible for lifting 51.6% of families out of poverty, and pensions are sustaining the aging population. These two factors are acknowledged as the main drivers of economic growth. In fact, the Republic of Moldova is one of the few European countries that recognizes remittances as a main influencer of the economy, accounting for

[4] Data source: https://financesapp.worldbank.org/

26% of gross domestic product in 2014, which is among the highest share in the world [12; 15].

According to the World Bank data, a vulnerable political system, polarized society, adverse external environment, and skills mismatch in the labor market, along with climate-related shocks, are Moldova's biggest economic challenges. Transparency, accountability, and corruption are crucial concerns. Business confidence is low, and the macroeconomic framework remains vulnerable. External budget support, based on an agreement with the International Monetary Fund, has a high level of conditionality [15].

Continued economic stabilization, the advancement of key economic reforms, and the creation of a rule-based environment for businesses are the country's key goals. Moldova's large-scale emigration, combined with decreasing fertility rates, has led to an alarming decline in population and increased the share of elderly people. This puts pressure on the pension system and limits the country's long-term competitiveness. [ibidem]

Policies to promote healthier labor markets need to address the structural challenges to the extent possible in coming years, as follows [13, p. 36–37]:

- ***Aging:*** The country needs to prepare for the rapidly aging population. By 2060, the population is projected to have dropped by 29%, while the share of the elderly (ages 65+) individuals will have tripled to 30%. Given substantial migration, low fertility, and weak labor markets, the demographic dividend may vanish before the country has reaped the benefits. This raises serious questions about the ability of society and the economy to support a growing elderly population. Efforts to reduce old-age mortality accompanied by policies to improve education and health care and to promote active aging, can allow people to work longer and contribute more to the economy.
- ***Regional disparities:*** The gaps in welfare and access to services across urban and rural areas and among ethnic minorities call for more active engagement by the government to enhance the provision and quality of services in remote areas. Failing to address these barriers would risk widening inequality and undermining economic mobility and harmonization across the country. Improving the equitable access to and the quality of education, particularly among the less well off, is also key to increasing productivity and the opportunities to find jobs. Equity in access to services, including health care, without the currently high OOP[5] expenditures is also critical to permitting individuals to build up their human capital.
- ***Significant vulnerability:*** The vulnerability to external and climate shocks seems to be increasing, and this will affect more heavily those households dependent on the agricultural sector. The poor are more exposed to such shocks. Mitigation and measures to help households adapt to climate

[5] Out-of-pocket expenditure (% of current health expenditure).

shocks are needed. Social assistance can also be improved. The targeting of social assistance has been enhanced through the *Ajutor Social* and heating allowance programs, although they still represent a small share of total spending and cover only 4% and 6% of the total population, respectively. There is, likewise, room for improvement within the overall expenditure envelope, including program consolidation to provide room to expand the coverage of social assistance programs.

Previous analyses of poverty and equity in Moldova point to challenges similar to those discussed in the 2016 report. More than a decade ago, a similar World Bank document identified challenges related to the lack of sufficient investment in human capital accumulation by the poor, large spatial inequalities in living standards, dependence on pensions, increasing inactivity, and dependence on subsistence agriculture, substantial migration, and the poor coverage of social assistance [ibidem].

Moldova's National Development Strategy (2012–2020), approved in 2012, describes the country's **medium-term development priorities**. It calls for a shift from the current consumption-based paradigm towards a new growth model based on expanding investments, increasing competitiveness and productivity, promoting export industries, and developing a knowledge-based society. With the objective of *"ensuring qualitative economic growth and poverty reduction"*, it lists eight national priorities [2, p. 3]: 1. aligning education with labor markets; 2. increasing public investment in roads; 3. promoting financial sector competition; 4. improving the business climate; 5. raising energy efficiency, including the use of renewables; 6. ensuring fiscal sustainability of the pension system; 7. enhancing the efficiency and quality of justice, including combatting corruption; 8. fostering the competitiveness of agri-food products and sustainable rural development.

Undoubtedly, the World Bank is one of the most powerful financial organizations in the world, providing sustainable financing for a wide range of projects directed toward socioeconomic problems and poverty reduction. Due to the Bank's and other international organizations'contributions to the economies of developing countries, the world's poverty level has significantly decreased. In the past, the vast majority of the world population lived in conditions of extreme poverty. The percentage of the global population living in absolute poverty fell from over 80% in 1800 to 10% by 2015. According to United Nations estimates, in 2015, roughly 734 million people, or 10%, remained under those conditions. The number had previously been measured as 1.9 billion in 1990 and 1.2 billion in 2008. Despite the significant number of individuals still below the international poverty line, these figures represent significant progress for the international community, as they reflect a decrease of more than one billion people over 15 years [3].

Being the major channel of funds from rich and industrialized nations to poor non-industrialized nations, the World Bank's areas of interest, responsibility and activity evolved overtime. In 1950s and 1960s it assisted the developing world for the infrastructure necessary for industrialization while in 1980s its main task was

providing policy reform assistance for growth. Due to the rise of environmental degradation, income inequality and other global issues, the main tasks of the World Bank lied in the fields of environment, poverty reduction, private sector improvement, promoting the role of women in the development and governance (Miller-Adams 1999). Above all, the bank's 2030 vision says more about its main current concerns. By 2030, it aims to (1) end extreme poverty by reducing the percentage of people living on less than $1.90 a day to three percent at maximum and (2) promote shared prosperity by fostering the income growth of the bottom 40 percent for all countries (World Bank 2016a).

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Being the major channel of funds from rich and industrialized nations to poorer, non-industrialized nations, the World Bank's areas of operation evolved overtime. In 1950s and 1960s, it assisted the developing world with creating the infrastructure necessary for industrialization, while in the 1980s, its main task was providing policy reform assistance for growth. Due to the rise of environmental degradation, income inequality, and other global issues, the main tasks of the World Bank lied in the fields of environment, poverty reduction, private sector improvement, promoting the role of women, and governance [9, p. 40].

However, the World Bank faces policy failures and criticism, particularly with respect to its loan conditions for borrower countries. Conditions are significant because they tend to lock in a donor-driven reform agenda in recipient countries. Loan conditions are part of the World Bank's Development Policy Financing (DPF) and have long been criticized by civil society, academics, and developing country governments. They undermine borrower country ownership and restrict policy space, and often have harmful impacts on the daily lives of individuals, especially with respect to the world's poorest and most vulnerable people [4].

The European Network on Debt and Development examined the World Bank loan conditions for 2017. This study focused on prerequisites: the conditions borrower countries must fulfill before loans are disbursed. The report shows that the Bank continues to attach controversial economic policy conditions to its operations, which undercut democratic ownership of development policies. In different countries, World Bank conditions have triggered fiscal austerity and reduced budgets for public sector workers, the privatization of public services due to the promotion of public-private partnerships laws, and market liberalizations that benefit big corporations to the detriment of small and medium enterprises and smallholder farmers [4].

Even though international economic institutions including the World Bank play a major role in the international arena and contribute to different areas, they face overwhelming criticisms from economists, professionals from other fields as well as leaders and citizens of various countries, particularly from developing countries. People always question the aim of existence of those institutions, whether they exist to assist them.

Even though international economic institutions including the World Bank play a major role in the international arena and contribute to different areas, they face overwhelming criticism from economists, professionals from other fields, as well as leaders and citizens of various countries, particularly from developing countries.

The main aspects for which the Bank was criticized are the following:

The globalization of market forces,promoted by the World Bank, creates greater inequality and strengthens control of the rich over markets. The World Bank, among other influential international organizations, is criticized for pressure it has put on governments to remove barriers to the cross-border flows of money and goods, freely introducing foreign capitalinto the investment fields of developing countries and creating the dominance-dependence system that helps the rich become richer [10;9, p. 41].

Financing countries that do not really need lending. Since 2009, the World Bank has provided 40% of loans to high-income countries that, objectively, do not need this financing. A prime example is China. At the end of 2015, China founded an international development bank, the Asian Infrastructure Investment Bank. China is one of the founders of the New Development Bank, created by BRICS members. But even after creating two competitors of the World Bank, China continues to use the World Bank's financial support [9, p. 41–42; 20].

Promoting the Washington Consensus through its close participation with the IMF in lending only to programs that are heavily conditioned. To join the World Bank, a country must initially join the IMF and accept its conditions – adjustment policies – on loans. Liberalization of prices, liberalization of trade, shift toward export, and privatization of the public sector comprise the basis of the adjustment programs. Some critics comment that, due to the structural adjustment policies, the majority of the population suffers lower wages, reduced social services, and less democratic access to the policy-making process. As part of the standard structural adjustment package, the World Bank encourages countries to expand their exports so that they will have more currency to make payments against their foreign debts, but this leads countries to overexploit their natural resources. Deforestation chemicalization of soil for more efficient agricultural production, and, demineralization of ground resources contribute to the degradation of environmental conditions [10; 9, p. 42–43].

Causing major damage through development projects. World Bank funded projects have also continually been found to be in direct, serious violation of international human rights standards. Major recurring issues include mass evictions and the forced displacement of peoples and communities for major infrastructure and agricultural projects, violations of the rights of indigenous and forest peoples, targeting of human rights defenders, engendering local food insecurity, and serious labor rights violations, such as child and forced labor reportedly being used in Bank-funded projects [16].

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BUSINESS MANAGEMENT STRATEGIES IN CRISIS

Abstract. *In different concepts, the crisis management is treated as a situation of preventing the insolvency or of managing the company in risk situations. The anti-crisis management is a component part of the management, oriented towards the management of the vulnerability of the company, which consists of several stages, among them are: management during the absence of crisis, identification of the crisis and management of the company during the pre-crisis period, management of the company during the crisis period the management itself during the restoration period. Considering that the company needs a post-crisis strategy. The management as a management system under the market conditions ensures the orientation of the company towards meeting the needs of the market, towards the demands of potential consumers, the organization of those types of activities, which are able to bring the enterprise an efficient result, to prevent or liquidate crisis situations in business. Anti-crisis within the company represents an operating system of measures to reform the entire management system with the identification of probable risks, being a vital method under the current conditions. We mention that the crises in the activity of the enterprise are an objective reality, we suppose that they reflect the inconsistency of the development rhythms of the enterprises with the need to change the development trajectory under the influence of the macro cycles. The cause of the financial crisis in companies is characterized by the non-compliance of the financial-economic characteristics with the parameters of the external environment, which in turn leads to the choice of an incorrect strategy, the inadequate organization of the business and as a result, the poor adaptation to the market requirements. It is assumed that the crisis situations are positive and contribute to the formation of the tools to announce the occurrence of the "weak point" and to develop a "new development stage". Therefore, the emergence of crises in the activity of the company is one of the conditions for its progressive growth and its renewal.*

Key words*: enterprise, financial crisis, financial management, insolvency, risk, stability, strategy, uncertainty.*

JEL: *G32, G33, M 210*

1. Introduction

The basic role in the management system of the company, under insolvency conditions, lies with the implementation of internal financial stabilization mechanisms. Their efficient application allows not only to remove the financial stress of the danger of insolvency, but also to a large extent will save the enterprise from applying for loans and will increase the pace of economic development.

All the methods and proposals allow the accumulation of the previous, analytical and forecast information, which envisages the possible changes of the

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financial situation of the company and elaborates measures to maintain the stability, by this, actively solving the cause of the insolvency.

The external environment itself includes objective economic, social and political conditions, within the limits of which the company activates and to the dynamics to which it is forced to adapt. Regarding the problem of uncertainty, we can say that it persists at all stages of the life cycle of the company and is due to the multitude of participants in the business process, whose behavior, in various situations, cannot be accurately predicted.

At the same time, the activity of the company is also influenced by strategies, goals and criteria, which cannot be invariable at the appropriate level of performance. In the meantime, we emphasize that, the activity of the economic agent is permanently affected by the uncertainty of the economic situation, which is based on the instability of the demand and the supply of goods and services, the factors of production, the existence of more possibilities of combining capital for making investments.

Thus, the management mechanism for most companies should not be aimed at avoiding the crisis, but at preventing insolvency and ensuring the possibility of identifying the critical state.

2. Risk – the variable of maintaining the solvency level of the enterprise

The activity environment imposes on the company a new variable that must be taken into account in order to maintain the liquidity level, namely – the risk, which is the uncertainty of the company with respect to the obtained results.

The current concerns of research and action in financial management concern the issue of risk and inflation. The risk is addressed in correlation with the inflation, the increase of the interests in the conditions of a high inflation, leading both to the increase of the cost of capital, and to the diminution of the potential of an investment to produce profit.

Risk is a measure of the concordance between different possible outcomes, more or less favorable or unfavorable in a future action. The risk can also be defined as the probability that the expected result will differ from the real profitability. The deciding person alone sees if the result obtained will be rewarded.

The risk assessment brings to it how comfortable the decision maker feels, being aware of the likely negative results. The risk should be seen as a possibility of losing or earning money.

The risk (the possibility of getting into danger, of facing a problem or of suffering a loss, possible danger) calculated and assumed by the initiator of the business has as a reward the expected profit of the business. It reflects the degree of probability associated with failure, and the key character of business development is the entrepreneur himself. [Julien P. A., et al.]

The entrepreneur can assume in his activity the following categories of risk: the strategic risk, assumed by the entrepreneur in the case of his own business,

depending on the choice of activities according to the competences of the entrepreneur, the resources available to him and the positioning on the market of the business, the risk financially, supported in relation to the capital committed by the company, is characteristic by the risk of non-repayment of the loans and the operational risk, derived from the possible malfunctions in the management of the resources.

The operational risk is assumed almost exclusively by the entrepreneur and can be avoided or limited only because of his possession of true qualities of manager, professional of the business. On the other hand, the entrepreneur faces uncertainty, often himself contributing to its emergence. Uncertainty (lack of certainty, uncertainty, doubt, hesitation) is of several types and it, manifesting itself at various levels, represents the set of potential events likely to occur and which can be predicted, thus influencing the activities of the company [The explanatory dictionary of the Romanian language; 2000].

Therefore, we consider that the financial risk indicators are able to explain some phenomena of negative influence of the risk factors on the activity of the company and based on them forecasts can be elaborated in order to avoid or minimize the future risks. As a result, the problems of insolvency risk are centralized on two financial statements, namely:

− the condition regarding the working fund;

− the state of solvency highlighted by several rates.

In order to assess the financial stability, it is necessary to calculate indicators that characterize the structure of the sources of heritage formation. One of the indicators is the correlation coefficient between the borrowed and own sources.

The larger the size of this coefficient, the greater the risk of entrepreneurship, which requires the implementation of methods to reduce and avoid this risk.

Among these methods we mention the diversification, which allows a greater stability of the financial performance, thus reducing the vulnerability of the company; this consists in the distribution of capital over different fields of activity, the results of which are not in direct interdependence. Due to the multiplication of production, the impact of adverse economic fluctuations in the sector can be mitigated, the risks related to imperfect forecasting, market shrinking or the emergence of new competitors are diminished.

When loss is obtained in one field of activity, profit is obtained from another sector. It follows that diversification allows to maintain the stability of the enterprise regardless of the internal and external factors that influence negatively.

Another method is the insurance of the risks of an insurance company, often the hedging is used, that is to say the price of the goods against the risk or the unexpected decrease for the producers and the unsatisfactory increase for the consumers.

The method of limitation involves setting a ceiling for the amount of expenses, the sale in credit and the investment amounts of the capital.

The formation of the reserves of resources to cover some unforeseen expenses is done by the correlation between the potential risk and the increase of the expenses to bear these risks. This method, as a rule, is used when implementing different projects. The risks are divided between the project participants, the longer the investment period and the more modern technologies are innovated, the higher the project risk. As a method of risk sharing, factoring operations appear which ensure high risks.

The decrease of the efficiency of a company, the loss of speed in the market, creates a negative state, the managers coming with numerous "saving solutions" to prove their managerial potential still unfulfilled.

And the financial requirement includes the fulfillment of at least two conditions: how much it costs to assimilate the proposal and what profit the respective proposal brings.

Taking into account that the driving force of the development of the entrepreneurial activity is the uncertainty and the risk, which have an objective character, we mention that they are the result of the influence of the external environment factors and, from these considerations, the emphasis is placed on ensuring the reciprocal connection between the forecasting process and the result of the current reality.

3. Strategies for managing instability and avoiding the financial crisis within the enterprise

According to some opinions, the insolvency, as an economic category, represents a reflection of the insufficient gross income destined to cover the expenses incurred. However, in case that as a criterion of the insolvency of the company, it serves the inability to use the factors of production, which have a certain level of efficiency, that is, the activity of the economic agent is lost, the following statements can be made:

- the unsatisfactory state of the enterprise produced by the loss effect does not characterize the phenomenon of insolvency, since it may be the result of the market strategy of the economic agent, because, in this case, the losses aimed at achieving long-term stability are of short duration;
- the non-profit activity of the enterprise cannot serve as a guarantee of maintaining the efficiency and solvency of the management object, as incorrect investment policy, the inefficiency of the organizational and management structure, as well as other factors, may lead to diminishing profitability. As a result, the company maintaining the state of technical and production potential will become insolvent as an object of entrepreneurship. Thus, the non-profitability reflects only the final side of the insolvency criterion, when the unfavorable situation of the company becomes visible to all business partners.

Therefore, from the foregoing, several reasons for insolvency can be stated. The first is the long-term decrease in demand, which is about ending the production life cycle or changing the demand function of the enterprise production, which can transfer the price level into the segment, which is below the average cost level.

The second assumes that as a result of the spontaneous increase of permanent or variable expenses, the overall costs may increase to the level that exceeds the price of the commodity.

As can be seen, the first reason for the insolvency arises from the field of marketing and provides that the marketing strategy is the starting point of the general plan of financial recovery of the economic agent. The second reason is attributed to the financial sphere, and the financial restructuring strategy is the final point.

Thus, the notion of insolvency risk management involves such a procedure, in which the crisis danger is stipulated in a certain way, the analysis of its particularities is carried out and the measures are elaborated, related to diminishing the consequences of the crisis and the use of factors, which will influence the development of the perspective of the company.

In the case of the emergence of the insolvency risk, for the management of the activity a great importance is due to the use of the contemporary methods of securing and using the reserve funds, as well as of their distribution systems.

The elaboration of the strategy regarding the consolidation of the financial situation of the company implies the existence of a process of efficient economic management of the patrimony, which involves a complex of organizational, technical and financial measures, which will allow the optimal correlation of the production factors. The manager's abilities to mobilize the collective to overcome the crisis situation are not the last place.

A big problem in the strategy of managing instability and avoiding the financial crisis is correlated with the non-effective management, sometimes it is enough to change the team of managers and implement the anti-crisis management policy, in order to record a financial growth and efficient economic results, that will allow the regular payment of the salary and the debt settlement to the state budget.

Therefore, the entrepreneur assumes responsibility for the development of an individual program of actions that would allow identifying, reducing and avoiding his own insolvency. Activating in the competition environment, the economic agent is required to offer his clients facilities for selling the goods, including the sale in credit, which conditions the probabilistic character and a high degree of risk. [Fomin, Ia.A.; 2004]

The economic and financial management of the company is a complex of correlations, which are formed in the process of developing and carrying out the activity between different elements of the material structure, the technical potential and that of the human resource, which express the possibilities of production, how they are used and which are the results obtained. At the same time, it is necessary to compare them with the possible level of attainment, depending on the potential existing in the equipment.

Currently, considering that the entrepreneurial activity is carried out under the conditions of an uncertain environment, the problem of evaluation, analysis and management of financial instability and crisis requires a study, which would include theoretical as well as practical aspects. Therefore, they must become a key element of the theory of economic management.

The management procedure allows appreciating the ways and possibilities of ensuring the economic stability of the company, its ability to withstand adverse events. In the process of examining the sphere of financial crises, it is necessary to consider the level at which the company is assigned and the stage in its life cycle.

Regarding the economic management, we affirm that, it can be treated as a specific process, which consists of a set of planning, organizing and control activities aimed at establishing and tracing the goals and objectives, to be achieved, as well as the interaction of the economic means that allow to achieve these goals, including a complex of efficient forms of administration of the entire patrimony of the enterprise.

The anti-crisis management involves the prior elaboration of a program to avoid critical situations, to insure against risks and to eliminate the negative consequences. There is an essential difference between stable planning, which is based on the use of certain resources, and between planning to restore normal business activity, because before unforeseeable and unpleasant phenomena, it allows the economic agent to restore in a short time its solvency and fulfill, as far as possible, its commitments towards its customers, partners and employees.

In the specialized literature, the process of carrying out the procedures for confronting the financial crises related to the activity of the debtor companies, is considered as a process of avoiding the crisis, which in the conditions of the market economy is considered as a directed process.

This situation highlights two concepts: crisis management and crisis regulation. The first is a microeconomic category, which represents all the forms and methods of carrying out the crisis avoidance procedures stipulated in relation to the corresponding enterprise. This category reflects the relations of production, which are formed within the enterprise at the stage of its recovery or liquidation.

The second, as a macroeconomic category, includes organizational, economic, normative and legal measures of influence from the state, which have as purpose the protection of enterprises against crisis situations, the prevention of bankruptcy or liquidation in case of inoperability of their functioning in perspective.

Some scientists emphasize the preventive procedures for avoiding the financial crisis and consider that the anti-crisis management is aimed at not admitting the bankruptcy of the company. According to the given approaches, the determination of the essence of the anti-crisis management manifests itself to some extent in the narrow sense, as it provides the management process under the conditions of the existing financial crisis and is directed towards the enterprise's exit from the given situation. The main cause in the management of the financial crisis is to ensure the conditions, in which the financial difficulties cannot have a permanent and stable character.

Thus, the notion of anti-crisis involves the operation of a system of enterprise management, with a systemic and complex character, which aims to prevent or avoid unfavorable phenomena for business, to implement and realize, within the economic agent, a special strategic program, which allows to remove temporal difficulties, keep and extend from the source, in different circumstances, the positions of the subject on the market.

At the same time, such formulation of this category does not allow revealing the structure of crisis avoidance management and does not determine the importance of financial restructuring in the case of the company's recovery.

The managerial theories determine that crisis avoidance management must a priori overcome and prevent the insolvency of the enterprise. The use of management procedures allows ensuring, over a long period of time, such a level of competitiveness, which will create conditions to produce the required goods on the market and would ensure sufficient monetary flow to pay all obligations [Hada, T.;2013].

Based on the above, the management of the financial crisis can be divided into the following modules:

- analyzing the external environment of the internal potential of the competition priorities;
- preventive diagnosis of the causes of crisis situations in the economic and financial processes of the company;
- complex analysis of the economic and financial situation of the company in order to establish the methods of financial recovery;
- the business plan for the financial recovery of the company;
- procedures for managing financial crisis avoidance and controlling their execution.

This determination of the anti-crisis management reflects its structure and content, as the first three modules are aimed at determining the current state of the enterprise, and the last two aim at removing it from the crisis.

From this point of view, the management of the activity of the company under the conditions of bankruptcy can be studied as a guided process, which is aimed at preventing or avoiding the crisis, which corresponds to the goals and the objective tendencies of development.

In this context, the problems of anti-crisis management of the financial position of the company can be reflected in the following three groups: [Yon, G.B.; 2004].

1. includes the problems related to the detection of the insolvency status;
2. it comprises the key spheres of the volatility of the enterprise, namely, the methodological, economic and financial problems;
3. differentiate the management technologies, which include the problems of crisis forecasting.

Thus, the notion of crisis management consists in the financial restructuring of the company and the modeling of processes, which refers to different groups of problems.

The assertions allow us to conclude that insolvency is a complex feature that reflects the internal processes, carried out within the company, which ultimately affect its financial status. Thus, for most management subjects, the management mechanism should not be aimed at avoiding the crisis, but should foresee the prevention of insolvency and ensure the possibility of preventing bankruptcy.

At the same time, regarding the insolvent enterprises, we mention that the main direction of the anti-crisis management consists in the financial restructuring.

Any management decision is made when the results are not yet known and the information is limited, so some principles of risk mitigation must be taken into consideration, namely: you must not risk more than your own capital allows, you must not forget about the consequences of risk, do not risk much to get little.

4. Conclusions

The structure of enterprises largely determines its ability to respond to changes in the external environment. If an enterprise has an organizational structure that is too rigid, it can become an obstacle to flexible adaptation to new real conditions, impede the process of innovation and impede a creative approach to solving new problems and tasks.

The manager should maximize the resources of the enterprise and distribute them in such a way as to have the greatest effect. The mechanism of using the resource potential of the enterprise is brought into line with the ongoing anti-crisis policy. When conducting a comparative analysis, it is important to highlight those points that can fundamentally affect the success of the enterprise.

At the stage of implementation of the anti-crisis policy, the top management of enterprises should revise the plan for the implementation of the new strategy, if this is required by new circumstances.

Analytical information should allow to determine: the reasons for the change in the financial condition of the enterprise; the composition of measures taken by the management of the enterprise to prevent deterioration in financial condition, the degree of their sufficiency and effectiveness; ideology and directions of forming a business plan and investment project; the depth of the crisis in which specific enterprises, types, forms and conditions of state support find themselves.

Monitoring of financial activities for a wide range of indicators, the results of the analysis of business plans and investment projects will allow you to quickly assess the financial condition of insolvent enterprises.

Since the insolvency of the enterprise can be eliminated in a short period due to a number of emergency financial operations of an operational nature, the remaining reasons that led to the crisis will lead the enterprise to crisis again. Therefore, it is necessary to restore financial stability by overcoming the causes of insolvency in a relatively longer period of time.

In practical terms, financial decisions should be aimed at increasing working capital and reducing the need for working capital. Of course, in a crisis situation,

when the possibilities of a significant increase in the volume of generating own financial resources and attracting long-term borrowings are limited, the main direction of ensuring the achievement of the financial equilibrium point by the enterprise is justification of the optimal need for working capital.

To obtain a positive result at enterprises it is necessary to rationally use their own fixed and circulating assets, significantly reduce production and administrative costs and significantly increase the volume of activity based on market conditions.

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ECONOMIC VULNERABILITY[4] – CONCEPT AND INDICATORS[5]

Abstract. *The paper addresses the economic vulnerability, in general, and of the households of population in Romania; in particular, from the point of view of the main theoretical approaches and the connections with other economic concepts relevant for the assessment and characterization of standard of living, namely those regarding poverty, well-being, resilience. The analytical approach is based on a relatively expanded system of indicators gathered within a methodology taken from the international literature, adapted by the authors to the limitations posed by the availability of relevant statistical information and data.*

Key words: *economic vulnerability, living standards, well-being indicators, exogenous shocks, resilience.*

JEL*: D11, D12, E21, I31*

Introduction

The identification of vulnerabilities and the exposure of countries, regions, communities, households and individuals to exogenous economic shocks has lately become an important issue. Vulnerability is not a simple concept and there is no consensus as to its precise meaning. Generally, this refers to a potential loss or deterioration due to external/exogenous shocks. In other words, the economic vulnerability refers to the risks caused by external/exogenous shocks to the production, distribution and consumption system.

1. Defining the relationship with other economic concepts (welfare, poverty)

In the opinion of Adger *et al*. (2004), the vulnerability of a system, population or individual to a threat refers to their ability to be affected/impacted by it. According

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[5] The paper represents the partial valorisation of the research study "Evolutions and perspectives of welfare, poverty and sustainability of the consumption patterns of the population in Romania, 10 years after joining the European Union" coordinator Marioara Iordan, manuscript, IPE, INCE, Romanian Academy.

to Briguglio *et al*. (2008), the economic vulnerability is attributed to the inherent conditions that affect the exposure of a country (or region or household) to exogenous shocks.

Guillaumon (2007) states that the economic vulnerability of a country can be defined by the risk of seeing its development hindered by the exogenous shocks to which it is exposed. It states that there are two main types of exogenous shocks or two main sources of vulnerability:

1) environmental or "natural" (natural disasters): earthquakes or volcanic eruptions, the most common climate shocks, such as typhoons and hurricanes, drought, floods; 2) external shocks (related to commerce and trade relationships), decreases in external demand, instability of world commodity prices and correlated instability of trade terms), international interest rate fluctuations.

Vulnerability, as defined by Hoddinott and Quisumbing (2003) represents the probability that, at some point in the future, an individual will benefit from a level of well-being under a certain standard of reference: for example, the likelihood of being poor, aging or poor in the old age. From an economic point of view, well-being is generally expressed in terms of level of income or consumption, as well as regards the level of reference or benchmark, and as poverty level.

The review of the specialized literature highlights the side-by-side use of the vulnerability concept with the notion of poverty, but not synonymous with the concept of poverty.

Lipton and Maxwell (1992) explain, by contrast, that vulnerability is a dynamic process: it captures the changes that occur at the level of well-being of the individual/people by moving within and outside the poverty line. Therefore, for vulnerability assessment, time series data are needed in order to capture the long-term process of change in the vulnerability indicators. Moser (1998) states that although the poor people are usually the most vulnerable, not all the vulnerable people are poor, a distinction that can facilitate the differentiation among the low-income populations.

Chaudhuri *et al*. (2002) state that vulnerability is an *ex ante* concept (future-oriented), rather than an *ex post* concept. The state of poverty can be observed in a certain period of time, given the measure of well-being and the poverty line. In contrast, the vulnerability of households is not directly observed, but rather can only be predicted (the household will become more vulnerable to shocks only on the assumption that no other factors will change).

Hoddinott and Quisumbing (2003) mentioned three main approaches: (1) vulnerability as expected poverty; (2) vulnerability as expected low utility; (3) vulnerability as an uninsured risk exposure. The three approaches share the fact that they refer to an assessment/estimation of well-being, namely a measure of well-being that can be a type of consumption, or, in another alternative, well-being indicators might be used.

At the same time, vulnerability has several dimensions, which should be taken into account in the process of identifying the impact factors/vulnerability

indicators. According to several authors, such as Blaikie and Brookfield (1987), Bayliss-Smith (1991) and Moser (1998), two dimensions of vulnerability are used: (1) sensitivity, that is, the magnitude of response to a shock of the individuals, households and communities; (2) resistance/resilience, the ease and speed of individuals, households and communities to recover from a shock.

According to Moser (1998), the vulnerability analysis involves identifying not only the threat but also the "resilience", or responsiveness in exploiting opportunities, and resistance to or recovery from the negative effects of a changing environment. The author addresses the vulnerability as insecurity and sensitivity in well-being (measured by the total income or the value of the total assets held) of individuals, households and communities facing an environment undergoing a process of negative change (ecological, economic, social and political).

Briguglio *et al*. (2008) associate economic resilience with actions undertaken by policy makers and private economic agents meant to provide support to a country to withstand/recover from the negative impacts of shocks (for example, production declines, poverty growth).

Guillaumon (2007) agrees with the two above-mentioned dimensions, and also supports the nature of shocks, as well as another dimension of the approached concept – economic vulnerability. Specifically, he argues that vulnerability can be understood as the result of three components: (a) the size and frequency of exogenous shocks, either observed (ex-post vulnerability) or anticipated (ex-ante vulnerability); (b) the exposure to shocks; (c) the ability to react to shocks, or "resilience".

Hoddinott and Quisumbing (2003) highlight the vulnerability dependence on four main factors: (1) the nature of the shock (for instance, large scale disasters, such as drought, earthquakes, floods or landslides; world market instability; political instability); (2) the availability of additional sources of income; (3) the functioning of the labor, credit and insurance markets; (4), the degree of public assistance. Because the last three factors are determined by the available income, they are consequently dependent on the adaptability/resilience.

In conclusion, we may say that the level of vulnerability of a household/region depends on or is a function of three factors: the degree of sensitivity, the degree of resilience of the household/region and the nature of the shocks. Theoretically, it can be hypothesized that the function has a positive relationship with the first factor (more sensitive, more vulnerable), a negative relation with the second factor (more resilient or with a greater capacity to recover, less vulnerable) and a positive relationship with the third factor (larger or more severe shocks, higher vulnerability).

2. Vulnerability indicators

Evaluation of vulnerability is carried out with the help of the vulnerability indicators, selected as according to the following criteria: (i) adequacy (according to a concept framework or definitions); (ii) availability of data; (iii) shock sensitivity.

The literature pays closer attention to the individuals' or households' ability to recover from the aftermath of the shock/crisis, to the necessary actions that people have the power to undertake to deal with them. Knowing the resilience of individuals/households is very important for the policy makers, since a good knowledge determines the correct choice of the shapes / types of interventions needed to effectively help the poor during the economic downturns through poverty alleviation policies.

We present in the following a review of the representative indicators for highlighting the ability of individuals/ households/regions to deal with crises.

According to Streten *et al*. (1981), the capabilities of individuals/households to recover from a shock are highly influenced by factors ranging from the perspectives to earn their living, to the social and psychological effects of the deprivation and exclusion. These include the basic needs of the people, employment of workforce for reasonable wages and the facilities related to health and education.

Swift (1989) analyzes vulnerability and safety in relation to assets classified in his model into three categories, namely: (1) investments (human investments in education and health, as well as physical investments in housing, equipment and land); (2) supplies (for example, foodstuffs, money, and value assets, such as jewelry); (3) support from others for assistance (for example, on the basis of friendship, kinship, community, networks of patronage, government and the international community).

According to Moser (1998), the ability of an individual to recover from the negative effects of an economic shock depends largely on the owned means – which are assets and rights (such as labor, land) that he / she can mobilize and manage in order to face the hardships caused by the shocks. As a result, vulnerability is closely linked to the property rights over the assets: the more assets a person owns, the less is he / she vulnerable, and the highest the erosion/reduction of assets, the higher is the insecurity of the person.

In the case where the economic vulnerability is defined, in a general sense, as a loss of welfare associated with poverty or the shock, starting from the above-presented issues the identification of vulnerability indicators should start from the factors (direct and subsidiary) of welfare or incomes, the employment of workforce being a significant source of / welfare factor as well as a vulnerability indicator.

Depending on the level of aggregation, the economic vulnerability can be assessed at the macro level: country, region or community, as well as at the micro level: individual / household. Some macro-level indicators are considered as sensitivity indicators[6] and others as indicators of resilience[7], or both cases.

We further present some of the most important assessment indicators of economic vulnerability at the macro level.

[6] Sensitivity indicators refer to the inherent and permanent characteristics (which cannot be the object of policies and the governance), which make the regions / countries predisposed to shock waves.

[7] Resilience indicators refer to the ability to adapt to crises.

1) Size (indicator of resilience/sensitivity). The small size of a region limits the ability to benefit from economies of scale and constrains the production possibilities. There is no generally accepted definition of which variable should be used to measure the size of countries or regions and which should be delimitation point between a small region and a large region.

Frequently, population (number of settlers/residents) is used as an indicator of the dimension/size of a region (province, county) or a country.

Guillaumont (2007) considers that from among the many ways through which the size of a region can be assessed, the most significant is the number of its residents.

Production – production capacity – has a direct connection with population in order to describe the economies of scale. The population is considered as market of production from the point of view of demand and as a factor of production (employment) from the point of view of supply.

A large population allows for producing, theoretically at least, a larger output than a small population, *caeteris paribus*. In this context, the indicators used to measure economic size are GDP and population.

2) Density and population structure (indicator of resilience/sensitivity). The total population positively influences the economy, namely the economies of scale and the production possibilities. Overpopulation can have negative effects on the production of wealth. The hypothesis is that, beyond a certain threshold, population density and production capacity or future per capita income may be negatively correlated: too much people in a certain area, less space for production, *caeteris paribus* (so that beyond such a threshold population density and vulnerability tend to be positively correlated).

The structure of population by gender and ages is also important in determining the vulnerability of regions. The regions where the marginalization of women is an issue are more vulnerable to shocks as compared to those where there is no gender discrimination. Also, regions where the share of the non-productive population is high are more vulnerable to shocks than those where the productive age category as a percentage of the total population is high.

3) Geographical location (sensitivity indicator). The degree of economic openness of a region is affected, among other factors, by the geographical location of the region. According to several studies, being far away from the world markets (for production as well as for inputs) is a structural handicap not only because it is a factor of vulnerability: even if transportation costs have decreased, distance remains a major obstacle to trade.

Thus, as a hypothesis, the farther a region is, the greater its sensitivity to exogenous shocks, *caeteris paribus*.

4) Economic openness (sensitivity indicator). According to Briguglio *et al*. (2008), the economic openness is, to a significant extent, an inherent characteristic of any economy, mainly conditioned by two factors: (1) the size of the country's internal market, which affects the ratio of exports to GDP (for example, a small

domestic market leads to higher exports, *caeteris paribus*, etc.) and 2) the availability of a country's resources and its capability to efficiently produce the range of goods and services needed to meet the demand of the internal market, which affects the ratio of imports to GDP (that is, the resource-poor countries and with lower capacity to produce effectively have larger imports, *caeteris paribus*).

A high degree of economic openness of a region may also be reflected by the ratio of foreign investment (capital inflows, plus capital outflows) to GDP. Without any doubt, a region with a high degree of economic openness is particularly sensitive to the economic conditions outside it. As mentioned in Briguglio *et al*. (2008), economic vulnerability is defined as the exposure of an economy to the exogenous shocks resulting from the economic openness.

Thus, the hypothesis regarding this indicator is the fact that regions with open economies face a greater vulnerability to shocks than the regions with protected economy, *caeteris paribus*.

5) Export dependency and its concentration (sensitivity indicator). The risk of a region being negatively affected by export instability is exacerbated when a large export dependence is found for a narrow range of exports. Or, according to Briguglio *et al*. (2008), the dependence on a narrow range of exports has resulted in related risks associated with the lack of diversification, and, in the end, exacerbated vulnerability associated with the open economy. In other words, the economically open countries, those with low export market diversification (higher concentration of export) are more susceptible to external shocks as compared to the opposite situation.

Thus, it can be assumed, given the ratio of exports to GDP, there is a positive relationship between the level of export concentration and the level of vulnerability, *caeteris paribus*.

6) Import dependency and its concentration (sensitivity indicator). Regions with a high degree of import dependence, especially strategic imports, such as energy, other essential natural resources and industrial goods, exacerbated by limited import substitution possibilities, are highly susceptible to instability in the world supply chains (availability) or in the world prices (cost of imports) pertaining to the respective import items.

On the one hand, we have as hypothesis the fact that the ratio of imports to GDP and the level of sensitivity to external shocks are positively correlated, *caeteris paribus*. On the other hand, another hypothesis is that, considering this ratio, the lower the diversification of the import market is (the higher the import concentration), the greater the vulnerability to external shocks is, *caeteris paribus*.

As a theoretical illustration, a significant increase in the world prices or a sharp decline in the global stockpiles for a globally marketable product may be a crisis for importers in times when this is a crucial commodity for them, for example, rice or oil (see the two oil crises: 1974 and 1980).

7) Share of processing industry / agriculture in GDP (sensitivity indicator). The contribution of the manufacturing industry or agriculture to the formation of GDP highlights the economic diversification of the economic system of regions/countries: a very large percentage share of the manufacturing industry or agriculture in GDP, reveals a higher economic concentration or lower level of economic diversification. Moreover, considering the demand level on the internal market (which, among other key factors, is determined by population size), a high level of economic concentration also means high dependence on imports (for other sectors with small GDP contributions).

Thus, the higher economic concentration in a region is, the more vulnerable to the external shocks a region is, *caeteris paribus*, but, of course, this depends on the sectors the shocks hit the most.

8) Share of sectors in total employed population (sensitivity indicator). Single dependence on an only one economic sector for income generation creates a form of economic vulnerability for counties/regions. As explained by Cutter *et al*. (2003), the boom-bust economies based on the development of the petroleum industry, of fishing, the coastal areas based on tourism are good examples – in periods of glory, prosperity, the income levels are high, but when the industries face harsh weather or are affected by a natural hazard the recovery may last longer. The agricultural sector is no exception and is probably even more vulnerable, given its dependence on climate (modification of the weather conditions, increases in the hydrometeorological dangers – floods, drought or hail). Thus, the yearly or decadal incomes are affected and, consequently, the sustainability of resource basis.

Therefore, as a hypothesis, it is possible to recognize that the regions where most of the workforce is employed in a single sector are poorly resistant to shocks as compared to the regions with a relatively equal distribution of workforce by sectors, *caeteris paribus*, which are less affected by shocks.

9) Real income per capita and income distribution (resilience indicator). Real income per capita is often used as an indicator of well-being, revealing the purchasing power of an economy. Thus, ideally, should be measured the total welfare (real value) per capita instead of the actual income (from employment) per capita. This total proportion of well-being as compared to total population is more appropriate to indicate the ability to absorb losses and increase resistance to impact shock hazard.

In such a context, the welfare hypothesis highlights the ability of the communities in rich regions to faster absorb and recover from losses than those in poor regions. However, a higher real income or wealth per capita will be meaningless when all the income/wealth obtained is not equally distributed among the population. In other words, even when the real per capita income is high, the poverty rate can also be high when the income disparity is high. Income inequality is often measured using a Gini coefficient.

Starting from the level of real income per capita, the higher the Gini coefficient (close to unit), the higher the level of vulnerability, *caeteris paribus*.

10) Percentage of population living below the poverty line (indicator of resilience). The share of the population in a region or a community that lives below the actual poverty threshold (poverty rate) indicates the level of sensitivity, as well as the resilience degree of the region/community to the external / exogenous shocks, because it is generally considered that only the individuals or households that are not poor (which own, for instance, money or assets), are more likely to stand up to a crisis than the poor ones.

Because the poverty rate and the employment rate (unemployment/ underemployment) are negatively (positively) correlated, the unemployment rate / underemployment (or employment) can be used as an alternative indicator of poverty and, consequently, of vulnerability. According to Mileti (1999) and Cutter *et al*. (2003), the potential loss of workforce employment as a result of a shock fast increases the number of unemployed workers in a community or a region, contributing to a slower recovery in the aftermath. Thus, a hypothesis is that the poor regions are more vulnerable and they face more difficulties in dealing with the crisis as compared to the rich regions, *caeteris paribus*.

11) Adult literacy ratios and school enrollments (indicator of resilience). Educational progress, as measured by two indicators of the human capital index, the literacy rate of adults and the rate of enrollment in education, is generally considered to be an important factor of the ability to cope with crises in the regions/communities.

Briguglio *et al*. (2008) argue that social development is another essential component of economic resilience and they consider the educational progress as a good indicator of social development. Also, it is important the difference between the literacy rate of women and that of men, or the literacy rate of women relative to the total population who can read and write. A related hypothesis is that regions with higher education levels of population are less vulnerable to shocks than those where most of the population has only primary school education, *caeteris paribus*.

12) State of health (indicator of resilience). As in the case of educational progress, the state of health is also another important indicator of human capital, given that high educational progress cannot be achieved in an unhealthy society. In other words, education and health go together, or they complement each other. Briguglio *et al*. (2008) also consider advancement in the health standard as a driver for economic resilience. The correlated hypothesis is that the healthy communities are better able to cope with a crisis supporting minimal damage/loss as compared to the unhealthy communities, *caeteris paribus*.

13) Technological capability (indicator of resilience). It is generally recognized that technology is the most important factor, apart from human capital, for economic development or economic well-being. The technological capability of a region is determined by several factors, including people's access to advanced technologies, through either formal education, or training, workshops, or self-learning, with full access to information (internet, newspapers, television, etc.).

Thus, the hypothesis related to this is that regions with higher technological capability are more resilient to exogenous shocks than those with low technological capability, *caeteris paribus*.

At national level, the most used indicators are R&D investment/expenditure as a percentage of GDP, number of scientists and engineers in research and development per million inhabitants and enrollment in tertiary education. At the regional/provincial level, in addition to enrollment in tertiary education, the number of research and development institutes, polytechnic universities, the number of scientists and engineers, as percentage of the total population, as well as the number of graduates of technical universities as percentage of the total population can be used as alternative indicators.

14) Social and economic infrastructure (indicator of resilience). Social and economic infrastructure, for example, schools, hospitals, public utilities, roads, bridges, ports, telecommunication facilities, transport facilities, sewerage, water supply, industrial properties, electricity, irrigated areas (for agriculture-based regions), etc., is a very important determining factor for the vulnerability or resilience of a region. The hypothesis is that the areas with well-developed social and economic infrastructures are facing lower vulnerability or they have higher capacity to adapt to shocks, as compared to the regions with underdeveloped infrastructures.

15) Social capital (indicator of resilience). Social capital is a critical factor in building and maintaining the confidence needed to ensure social cohesion and change. In the economic field, social capital is important as a factor of feasibility and productivity of the economic activities. Putnam (1993), for example, defines social capital "stocks" as informal (unorganized) and formal (organized) mutual trust networks and norms integrated into the social organization of communities, with social institutions in both hierarchical and horizontal structures. Adger *et al*. (2004) approach social capital as the ability to act collectively. According to Hoddinott and Quisumbing (2003), social capital includes networks, norms and social trust, which facilitate coordination and cooperation. Thus, a community with a well-developed social capital (reflected in the strong community level of trust and collaboration) faces a low vulnerability (or high resilience) to a shock, *caeteris paribus*.

According to Moser (1998), the ability of a region or community to respond to a shock does not only depend on the level of trust and collaboration of the community, but also on the social cohesion of households. Thus, social capital (at community/ macro level) and social cohesion (at household / micro level) are two invisible intangible assets that determine the crisis response capacity. The importance of social capital at the time of an economic crisis can be manifested in the forms of increasing dependence on the provision of informal loans (for example, through rural cooperatives instead of banks) or by increasing the networks of informal support between households or farmers through the association of farmers or increased activity at community level (Moser, 1998).

16) Participation of women in work/economic activities (indicator of resilience). The gender issue is more relevant in the less developed countries than

in the more developed countries or in the countries with greater female power or higher female emancipation rate. Because of the many restrictions the women are facing in such countries (culture, norms, customs, biased male religious practices), the level of marginalization of women is generally considered to be higher than in the developed world. On the other hand, women's emancipation or more opportunities for women to obtain a good education and economic/employment activities will reduce poverty. At the time of the crises, as stated in the literature, women may have more difficult times during recovery than men, often due to sector-specific employment, lower wages and family care responsibilities. Thus, regions with low levels of marginalization of women are less vulnerable to external shocks than those with low levels of women's emancipation.

17) Macroeconomic stability (indicator of resilience). Briguglio *et al*. (2008) consider macroeconomic stability to be an important variable in building a resilience index that captures the effect of shock absorption or shock counteracting policies. Macroeconomic stability refers to the existence of an internal economic balance, manifested by a sustainable budgetary, fiscal or public position, low inflation rate and unemployment rate near the natural rate, as well as by external balance. The latter is reflected in the balance of payments, the trade balance, the international current account position or through the level of external debt.

Regarding the fiscal position, the hypothesis is that larger fiscal deficit, lower sustainability of the state budget, means less resilience, and therefore greater vulnerability, *caeteris paribus*. At the regional level, the ratio of public expenditures to government revenues can be used as an indicator of regional fiscal sustainability. With regard to inflation and unemployment, the hypothesis is that higher inflation and unemployment rate mean higher welfare costs caused by a shock, and lower resilience, *caeteris paribus*. According to Briguglio *et al*., unemployment and inflation are often associated with the ability to adapt/resiliently absorb the shocks.

According to Adger *et al*. (2004) the ability of a country to pay for emergency planning or to finance recovery programs, will be affected by the level of debt. Moreover, the economic policy in heavily indebted countries is often driven by the international financial institutions that require structural and trade liberalization programs readjustment, which reduce the ability of governments in these countries to pursue policies that reduce vulnerability associated with poverty. Ndikumana and Boyce (2003) also found evidence that debt can encourage capital outflows, further aggravating economic well-being at the national level.

At the micro level, the most used indicators on the vulnerability of a household are the following (household features):

1) Occupation and status of head of the family. In general, families with unemployed heads of household are, *caeteris paribus*, more vulnerable than those with employed persons as heads of household (they have permanent jobs). Therefore, there is a positive correlation between employment status and salary/income level. In conclusion, the better the professional status of the head of household, the more the degree of resilience increases and the vulnerability of the household decreases, *caeteris paribus*.

2) Level of education of the head of the family. Theoretically, the level of formal education is positively correlated with the employment condition and the status of the head of household or with the salary/income (because the level of education is positively correlated with productivity, *caeteris paribus*). From their study of vulnerability in Bulgaria, using a panel data set for 1994, Ligon and Schechter (2003) found that households with educated, employed heads were less vulnerable to shocks than other households. Thus, the higher the formal education level of household head, the higher the resilience and the lower the household vulnerability, *caeteris paribus*.

3) Sex and age of the head of the family. Given the constraints faced by women in less developed countries, in general, families with female heads of household may be more vulnerable or have more difficulty in coping with external shocks, as compared to those with male heads. Regarding age, because age is negatively associated with productivity, beyond a certain age, which is considered to be the optimal productive age, it can be hypothesized that there is a positive link between the age of the household head and the level of vulnerability of the household; with the assumption that other factors remain constant.

4) Size of household and the employment and educational structure. A larger household is more vulnerable to a crisis than a smaller one, when the large household has a high number of economically dependent/non-productive/ unemployed or low-educated members. Cutter *et al*. (2003) explain that families with large numbers of dependents (or single-parent households) have limited finances for outsourcing care for dependents and, consequently, must carefully manage work and care responsibilities for the family members.

In a study on Southern China, Chaudhuri and Christiaensen (2002) compared a series of features of the poorest 26% (let us say group A) and the most vulnerable 26% (group B) of the households surveyed, finding that the average family size as well as the share of members with a high dependency ratio in group A are higher than in group B. The hypothesis related to this problem: the lower the size, considering the family structure or the better structure (low dependency ratio; low illiteracy rate), given the size, the higher the level of resilience and the lower the vulnerability, *caeteris paribus*.

5) Health conditions. Human capital is made up of education / skills and health. As with education, the health status of family members is also an important determinant of the family's ability to respond to a crisis. Related hypothesis: the better the health status of a family, the higher and lower, respectively, the resilience and vulnerability of the family, *caeteris paribus*.

6) Property over assets. The ability of a family to respond to an economic crisis is determined not only by income, but also by its total welfare, which is given by the income from employment plus the income that can be generated from all of its assets; for example, natural capital (land and livestock), physical capital (lodging, means of transport, agricultural tools); financial capital (for example, bank / savings account, outstanding net loans), as well as other assets of labor /

human capital. According to Hoddinott and Quisumbing (2003), all these assets (including social capital), by allocating them for a number of activities, for example, food production and marketing crops, as well as others generating income, determine the ability of households to respond to shocks. Cutter *et al*. (2003) built an index of social vulnerability to environmental risks (referred to as the social vulnerability index) for the US based on socio-economic and demographic data from 1990 at the county level. In their model, personal wealth is measured in addition to the income from employment, by the median values of the houses and the average rents. Using an analytical factor approach, their analysis shows that the wealth factor explains 12.4% of the variation. Thus, the hypothesis related to this is: the more assets a family owns, the higher the resilience of the family and the lower the vulnerability, *caeteris paribus*.

7) Location. According to Cova and Church (1997), Mitchell (1999), and Cutter *et al*. (2000), rural dwellers may be more vulnerable than urban dwellers to shocks due to lower incomes and dependence on extraction economies based on local resources (*e.g.,* agriculture, fisheries). In such a context, the features of households located in remote areas (for example, mountain, hill, rural areas) make them more vulnerable because they are less resistant to shocks (they face many constraints to recover), than households in open / fully accessible / urban locations, *caeteris paribus*.

3. Conclusions

The level of vulnerability of a household/region depends on or is a function of three factors: the degree of sensitivity, the degree of resilience of the household / region and the nature of the shocks. Theoretically, it can be hypothesized that the function has a positive relationship with the first factor (*i.e.* more sensitive, more vulnerable), a negative relation with the second factor (more resilient or with a greater capacity to recover, less vulnerable), and a positive relationship with the third factor (greater or more severe shocks, greater vulnerability).

Vulnerability assessment is carried out with the help of vulnerability indicators, selected by using as criteria: (i) adequacy (according to a conceptual framework or definitions); (ii) data availability; (iii) shock sensitivity.

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GLOBALIZATION OF TOURISM – BETWEEN LIGHTS AND SHADOWS

Abstract. *The article aims at a critical and objective approach upon the relations and their dynamics between tourism and the process of globalization, showing from the very beginning that the globalist valences of tourism are included in the very "genes" of these activities thousands of years old. At the same time, attention is drawn to the fact that the globalization does not stand for "condamnation to welfare". The dynamics of tourism and the comparative and succinct analysis of the specific aspects of large geographical areas (Europe, Asia, Africa, etc.) is another coordinated approach in this article.*

Key words: *tourism, globalization, regional tourism, natural environment, economic environment, crisis, quantitative dimensions, traditions, cultural valences, incoming tourism, outgoing tourism, market share.*

1. Introduction

Amongst the human activities, few of them have, since their appearance, the gene of globalization "inserted" within, so that, along with trade and war, this valence has been fully found in tourism activities.

Thus, according to the Greek explorer and writer Themistocles Papadimopoulos, the age of tourism goes back 2500 years (unless the historical expeditionary mission from Troy can be considered, to a certain extent, to be tourism)[4].

a. The so-called ***incipient*** (or ancient) ***tourism*** appeared during the Sumerian era and it went on under different forms in the Assyrian, Babylonian, and Egyptian times; the objective and the dominant destination of the "tourists" of those epochs was the balneological tourism and thus the tourists visited the anthropic constructions and places or the localities with curative properties (water, air, sludge, etc.); in this regard, there are a number of writings from the great Homer (500 BC). There is also a wealth of

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information on the so-called "international tours" of the philosophers, historians and mathematicians of those times (among which there were Pythagoras, Herodotus, Pytheas, Galeus, Strabo). According to the conceptions of the time, no one could become a true "master" without having performed such a tour at least once during one's lifetime. One should note that there are also other types of tourism: cultural (educational) tourism combined with exploration tourism, so that the "global" valences of tourism were beginning to structure and define more and more consistently.

The Olympic Games were largely a tourism activity and even a large-scale tourism activity (there were thousands and even tens of thousands of people moving from one country to another on these occasions, from one continent to another and who had to be provided accommodation, meals, travel, hygiene conditions, etc.).

The ancient priests also encouraged the religious tourism and pilgrimages (either to the Thebas temples of the god Aman, or to Abidas – to the temple of god Osiris or to Delphi – the temple of the god Apollon, etc.).

However, the strongest transport infrastructure was developed by ancient Rome (over 80,000 km of cobbled roads – a kind of highways of the Antiquity).

b. During the Middle Ages and the Renaissance, one can talk for a long time about ***incipient tourism*** because immediately after the collapse of the Roman Empire, there was a decline in tourism activities; the major causes were both the territorial fragmentation of the old empire, and especially the invasion of migratory peoples.

After the second century A.D., the religious tourism started again, which remained, in many ways, the main form of tourism until the XVth century, a century during which the great geographical discoveries began. Marco Polo, perhaps the most famous tourist in human history also originated in the Middle Ages.

The famed geographic discoveries had, according to the authors, a very "thin" tourist coverage, as they were, in fact, an economic, religious and military expansion, which resulted in unimaginable disasters and destructions in the human and historical plan (entire races of people disappeared, traditions and multimillennial cultures were devastated resulting in the recurrence of slavery). All this has little (or not at all) to do with tourism.

However, the "cultural tours" (which existed even in ancient times) reappeared so that the "recalibration" of educational tourism began to take place, which took on a great deal of importance during the 17th and 18th centuries. For example, for an English young man or young woman, a Grad Tour was carried out in 2–4 years of trips aimed at extending his or her horizon of knowledge in fields such as art, architecture, biology, geography, history, world culture; the most demanding journey

was the mandatory route including France and Central Europe with adjacent voyages to Spain, the Holy Land (Palestine) and Rome.

In summary, we can state that **the globalist vocation of tourism has increased** and in addition it must be emphasized that tourism was not yet a stand-alone activity but a secondary activity, as the major role of travel was mainly the discovery of new territories, the economic, religious and military-political expansion, the proselytism, etc., even if the tourist flows were made of predominantly elitist tourists.

As we come back to the global dimensions and characteristics of tourism, let us note the statements of the English poet Philip S. Worsley, made since the middle of the XIXth century: "Until today, the human society has not existed". The writer was referring, of course, to the fact that never could the actors be found in the "theater" or on the "stage" of the world all at once.

The world was trying to become, in its relevant, major aspects, a single social system, a single economic system, so that the global system was no longer just an environment within which particular societies, nations and nations are developing and evolving. Globalization is claimed to be also cultural, economic, political and historical. For many reasons that concern arguments with qualitative impact, we do not fully share such beliefs (the arguments will be presented in the final part of the paper).

Let us keep in mind the definition given by the World Tourism Organization: tourism includes the activities of people who "travel or live in places outside their permanent residence area for a minimum of twenty-four (24) hours but not longer than one consecutive year, for recreation, business or other purposes not related to the pursuit of a paid activity in the locality concerned".

Regarding this definition we will make a series of remarks that will show the necessity of adding new components, so that:

a. the mass dimension of tourism forces us to reconsider the environmental components and their impact upon tourism (and beyond);
b. the individual tourism is a component of tourism, together with the (organized) group tourism, which becomes increasingly relevant.

Therefore, we come up with the proposal that the two aspects should be highlighted in the definition of tourism : tourism encompasses all the activities carried out by a person or a group of people, for a period shorter than one year outside his / her ordinary life environment, for relaxation, information, for educational purpose, business and other cultural purposes, in order to recover the health and / or the capacity of work under the conditions of strict ownership and compliance with the requirements regarding the protection and conservation of the natural, cultural-traditional environment which is the subject of the tourists and tourism concerns.

2. Qualitative and quantitative dimensions of the tourism globalization

Without making the theory of globalization, let us emphasize that globalization is a relatively new term that defines a much older process and is

defined as the multi-causal process that has as its main result the fact that an (usually negative) event that manifests itself punctually in a certain place, region, country is transmitted and spreads very quickly in all other directions, regions, countries of the planet.

To talk about the globalization of tourism, as already shown, is a little superfluous and therefore, from a certain view point, it is quite too much because, through its "genes", tourism is an activity that exceeds national borders.

The globalization is one thing, the tourism corporatization is another thing and indeed, the latter has taken on new dimensions in the context of the current dynamics and processes of global socio-economic, political and military transformation. Accordingly, the characteristics of global tourism are, succinctly formulated, as follows:

a. The structuring of giant, corporate-type tour operators, of a regional coverage (the process is in full swing although, in more and more situations, the positive effects that are generally located, exclusively at the level of the corporations, have started more and more frequently and in more and more places, to be overcome, in absolute value, by the negative effects).
b. The increasing the role of infrastructures, in general and of critical infrastructures in particular (water, energy, transport, etc.) in carrying out tourism of high economic, social and ecological impact.
c. Tourism has become one of the main tools of communication and education at global level, among others, due to the negative effects generated and propagated by globalization.
d. The organization of the tourist destinations is another consequence of the global tourism which is structured out of the combination of three important factors:
   - the development of tourist offers with more and more "standard landmarks" (all inclusive, micro-excursions, entertainment and shows included in the price of tourism services, etc.);
   - from the definition of tourism to the practices of tourism "the differences" have become increasingly greater, on the one hand due to the very large annual number of tourists (of the order of hundreds of millions), which implies new approaches to the impact of tourism in various areas of great interest and, on the other hand, due to the emergence of increasingly aggressive means of marketing and advertising; as a result, beyond the diversity and wide range of prices, the tourism target becomes more and more seriously affected both in choosing and benefiting from tourist services.
   - the emergence and development of all kinds of "tourist niches", especially in relation to the so-called "sophisticated" or eccentric tourists.

For most countries of the world, by its nature, tourism is an economic activity comprising numerous cultural valences, of national, regional or local traditions

than, say, the production and marketing of Cola and McDonald's. Obviously, the mimicry, one of the fundamental characteristics of globalization, makes the sales chains of the two products to "suffocate" all over the world, entire segments of culture and traditions; however, there are chances that much of the cultural specifics and traditions will "avoid the ruthless bite" of globalization.

An image of the quantitative dimension of globalization covering the period 1950–2017 and estimates for 2030 can be obtained by briefly analyzing the data in the following table:

Table 2.1

The evolution of the number of tourists in relation to the population at global level (thousand of people)

No.	Specification	1950	1960(*	1965(*	1970	1975(*	1980	1995	2013	2015	2016	2017	2030
1	Tourists (mil.pers.)	25.3	71.2	115.5	169	220	278	528	1087	1184	1237	1322	1800
2	Population (mil.pers.)	2500	3068.5	3352.8	3637	4030	4423	4928	7154	7300	7416	7532	8500
3=½	%	1	2.32	3.44	4.64	5.46	6.28	10.71	15.20	16.22	16.70	17.55	21.2
4	IVBF (1)	100	281	456.5	668	870	1099	2087	4296	4680	4890	5225	7114
5	IVBF (2)	100	122.7	134.1	145.5	161.2	177	197	286	292	297	301.3	340

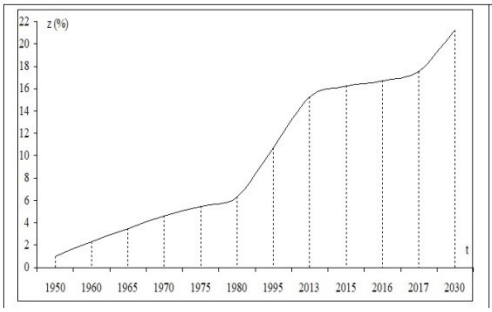
Source:UNWTO Raportul anual-2013,
http://cf.cdn.unwto.org/sites/all/files/pdf/unwto_annual_report_2013_0.pdf

We make the following notations:

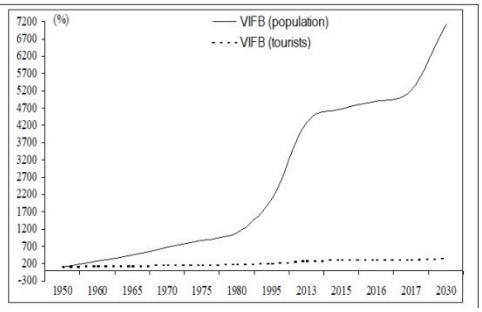
x = annual number of tourists [mil. pers.]
y = population [mil. pers.]

$$z = \frac{x}{y} \cdot 100 \quad [\%]$$

The graphical representation of the share of tourists in the total population (z) is presented according to graph 2.1:



Graph 2.1



Graph 2.2

Beyond the "expansion" of the indicator z (whose slope is close to 30°), it should be noted that, if in 1950, 1% of the population of the planet was part of the tourist category, in 1995, after almost half a century, the share of tourists in the total population of the planet was about 10.8%, so that 20 years later, the same weight would increase to 16.22%, and in 2017 the same share is 17.55% . For 2030 an estimated z = 21.2%, i.e. over 1/5 of the planet population will be a potential tourist!

If we graphically represent indexes of variation with fixed base (VIFB) for the total population and the number of tourists, then we obtain the following comparative dynamics:

The expansion that the index of variation with fixed base of the number of tourists registered after the 1990s shows the entry into a new stage of globalization as well as the planetary influence on the tourism, the geopolitical changes of continental coverage.

Although it was started at the end of the XVIIIth century, with an explosive expansion in the XIXth and XXth centuries, the industrial era induced rapid rates of consumption and technological development (interrupted by the two world wars) so that the consumption of raw materials, the consumption of goods and services, the process of urbanization but also processes such as labor migration have increased, as the incomes but also leisure time have increased visibly with the occurrence of the so-called midle-class.

All this made the "industrial tourism", as it developed alongside the industrial era, turn into "social tourism" (during the '50s –'90s) and then become a "mass tourism". The positive and negative valences of these multiple and quite rapid transformations are vast, profound and increasingly complex (in the sense that they do not concern or affect tourism alone).

The investments in tourism have become massive, permanent, autonomous and promote the corporatization process. At the same time, with a growing and increasingly complex conceptual baggage, tourism has also developed as a science in the field of economic sciences, with a specific research, conceptual and methodological system.

One branch of the science of tourism is represented by international tourism, which has conceptualized two very important categories of tourism:

a. the outgoing tourism which includes the departures of domestic tourists across the border, to other "tourist markets";
b. the incoming tourism, which includes the arrivals of tourists from other countries in one's own country.

The result of multiple entropic actions upon the environment following the industrialization of the industry, the chemization of agriculture, and in the field of tourism, the multiplication of the factors with negative action and destructive impact upon the nature has led to the emergence of the so-called ***sustainable tourism*** (according to the sustainable economy model), which has in principle, three important aspects:

– ***the balance***: the sustainable tourism represents an optimal mix between economic interests and corporate profitability, on the one hand, and the interests of the "host", respectively of local communities (environment, traditions, etc.);

- ***the quality***: improving the quality of tourism must go hand in hand with improving the quality of the environment and the life of the local communities that are the subject of tourism activities;
- ***the continuity***: globalization has, among other effects, that of "cultural leveling" or the principle of continuity opposes precisely this action, proclaiming the assurance of the continuity of the tourist resources and of the culture specific to the host community, of the perpetuation and preservation of its traditions.

In fact, without a conserved environment, without traditions and cultural specificity, the tourist resource is transformed from an inexhaustible resource into a rapidly consumable resource, in consonance with the so-called McDonald's or Coca-Cola culture!

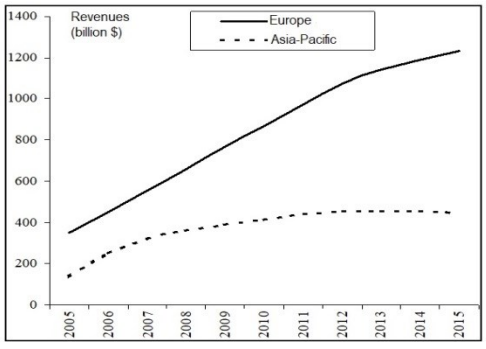
As we return to the international tourism, an image of revenue dynamics and market shares over a relatively extended time horizon is useful:

Table 2.2

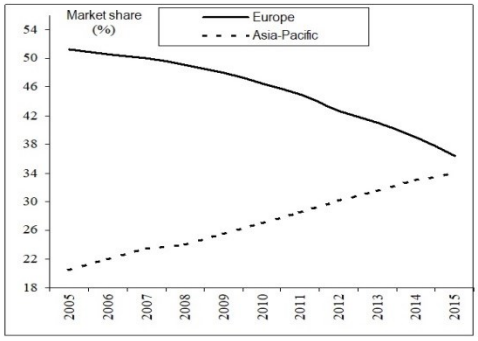
Revenue and market share dynamics

DESTINATIONS	REVENUES (mld. $)			MARKET SHARE (%)		
	2005	2012	2015	2005	2012	2015
GLOBAL LEVEL	840	1075	1232	100	100	100
EUROPE	348.2	457.8	448.1	51.2	42.6	36.4
ASIA-PACIFIC	138.6	323.9	418.9	20.4	30.1	34.0
AMERICA	144.6	212.6	277.2	21.2	19.8	22.5
AFRICA	21.5	33.6	33.2	3.2	3.1	2.7
MIDDLE EAST	27.6	47	54.6	4.0	4.4	4.4

If we graphically represent the dynamics recorded at the level of Europe, respectively the Asia-Pacific area, we would obtain the following comparative figures:



Graph 2.3.a



Graph 2.3.b

If on the level of revenues, Europe has the supremacy and also an ascending trend, in terms of market share, even if Europe still holds the first position, the systematic decreasing trend shows that the Asia-Pacific area will not be long in the second place (and at the level of market share but also at the level of tourism revenues).

It should also be noted that, although it has a relatively constant market share, the level of tourism revenues in the Middle East has practically doubled over the 10 years despite the political and religious climate (hostile not only to tourism activities).

In relative sizes and in the form of mobile based variation indices, the dynamics on continents of international tourists is presented according to the data in the following table:

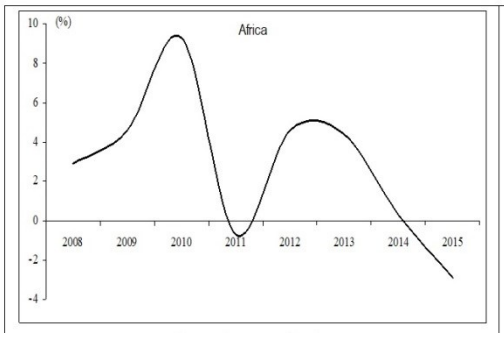
Table 2.3

Prospects for international tourist arrivals (%)

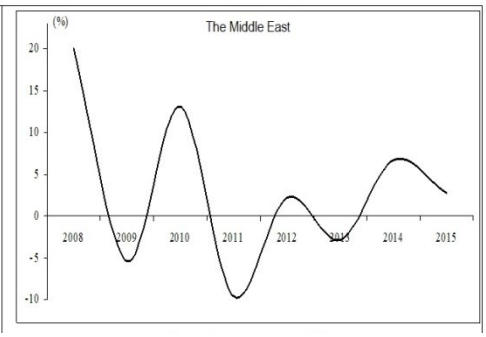
Destination	2008	2009	2010	2011	2012	2013	2014	2015	$\overline{M}$
Global level	1.9	–3.9	6.5	4.6	4.7	4.6	4.2	4.5	3.4
Europe	0.3	–5.1	3.3	6.4	3.9	4.8	2.4	4.8	2.6
Asia-Pacific	1.1	–1.6	13.2	6.2	7.1	6.9	5.8	5.4	5.5
America	2.7	–4.7	6.3	3.6	4.5	3.1	8.4	5.9	3.6
Africa	2.9	4.6	9.3	–0.7	4.6	4.4	0.3	–2.9	2.8
Middle East	20.0	–5.4	13.1	–9.6	2.2	–2.9	6.7	2.8	3.4

Source: UNWTO World Tourism Barometer, Volume 14, July 2016, p.4
http://cf.cdn.unwto.org/sites/all/files/pdf/unwto_barom16_04_july_excerpt_.pdf

a. A first point should be made after the comparative analysis of the dynamics of international tourists for Africa and the Middle East (Graph. 2.4.a and Graph. 2.4.b)

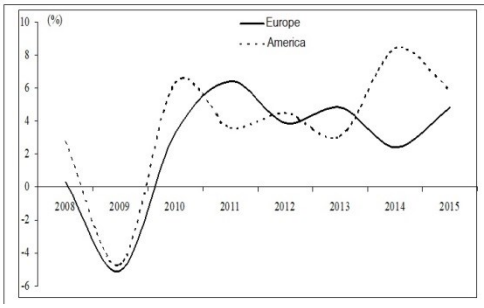


Graph 2.4.a

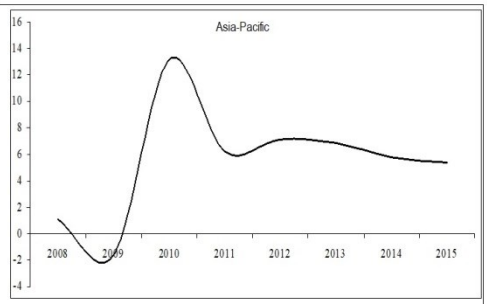


Graph 2.4.b

We proceed in a similar way for Europe, America and Asia-Pacific (Graph. 2.5.a and Graph. 2.5.b).



Graph 2.5.a



Graph 2.5.b

b. From the brief analysis of the graphs in fig. (2.4.a) and (2.4.b) (respectively the dynamics of international tourism in relative expression for Africa and the Middle East) a number of common aspects are observed:
   – the very high variability in time of the graphs shows, on the one hand, the extreme sensitivity of tourism to the political-military phenomena that systematically impact upon the two specified areas (a characteristic feature of globalization, as outlined above);
   – the decreasing trend recorded in Africa is accompanied, at the level of the Middle East, by the two "slippages" below zero, that is by the negative values of the variation indices with mobile base.

c. For the other two graphs (2.5.a and 2.5.b respectively), the comparative analysi reveal the following aspects:
   – Both in Europe and America, tourism was immediately and severely affected by the crisis started in 2008 but the recovery was relatively quick.
   – after 2009, a period of relative growth and stability followed, but under the conditions of a "functioning against time", of the tourism on the two continents, so that towards the end of the interval the "phase opposition" mentioned was amplified.
   – for Asia-Pacific, the impact of the crisis is noticeable but does not have the same magnitude as in the case of Europe and America; in addition, the return is extremely strong and subsequently amortized.

From the above brief analyzes, the influence of the globalization, in its various forms of manifestation, upon tourism, and especially the idea that the negative effects are spreading rapidly and globally, while the positive effects of the globalization are delayed and in a restricted and local social-political space.

Let us put some emphasis regarding the dynamics of the incoming tourism, over a longer period of time, 1995–2015 respectively. In this regard, let us consider the following statistical data:

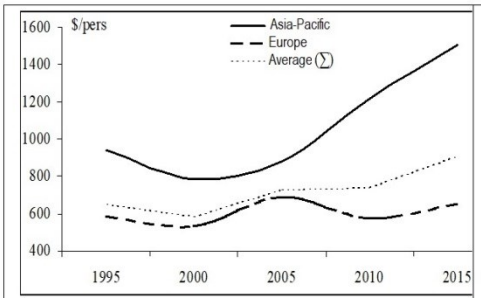
Table 2.4

The dynamics of the incoming tourism (revenues and tourists) between 1995 and 2015

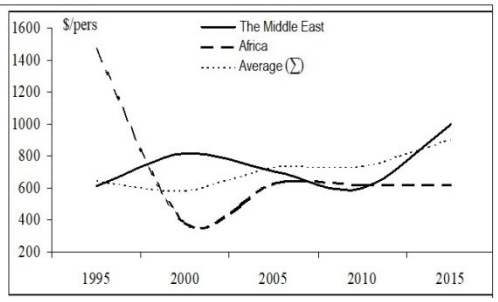
Continent/Region	U.M.	Year				
		1995	2000	2005	2010	2015
Asia-Pacific	mld. $	77	86	136	250	372
	mil. pers.	82	110	154	206	278
	$/pers.	939	782	883	1214	1504
Europe	mld. $	179	206	312	280	398
	mil. pers.	304	387	453	489	609
	$/pers.	589	532	689	573	650
Middle East	mld. $	8	18	24	33	54
	mil. pers.	13	22	34	55	51
	$/pers.	615	818	706	600	1000
Africa	mld. $	8	10	22	31	36
	mil. pers.	19	26	35	50	53
	$/pers.	1461	385	629	620	623
∑	mld. $	272	320	494	594	903
	mil. pers.	418	545	676	800	994
	$/pers.	650	587	731	742	908

Source: UNWTO Annual Report 2015. http://cf.cdn.unwto.org/sites/all/files/pdf/annual_report_2015_lr.pdf

The graphical analysis of the comparative dynamics of income / tourist highlights a number of relevant, particularly interesting and possibly useful aspects:



Graph 2.6.a. Graphical analysis of the comparative dynamics of incomes/tourist between Asia-Pacific and Europe.

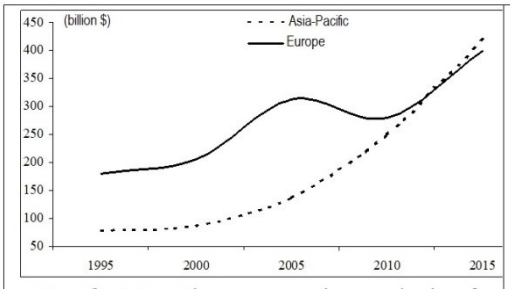


Graph 2.6.b. Graphical analysis of the comparative dynamics of incomes/tourist between Middle East and Africa.

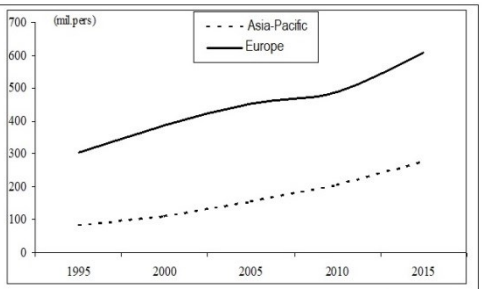
a. A first underline must be made in the direction of assessing the difficulty of making long-term forecasts, taking into account the random, unpredictable trajectories of the analyzed indicator, respectively the average income/ tourist.
b. It can also be observed that Europe was only geographical area in which the indicator was systematically below the average level recorded at the global level (∑), over the entire horizon defined by the 20 years.

c. It is worth noting the expansion registered by the indicator at the level of Asia as well as the "collapse of its values, easily detectable, at the level of Africa (1995–2000 period).
d. A possible explanation for the level of income incurred by a tourist, at least with regard to those recorded in Asia and Europe, could be that resulting from the comparative analysis of graphs 2.6.a and 2.3.b (although time horizons are not identical), namely that:
   – On the one hand, Europe loses market share and believes that a lower rate level in tourism will preserve what it has and may even guarantee a return to the tourism services market.
   – On the other hand, the Asia-Pacific area is experiencing a strong expansion in the market and having a solid share of it, it can afford higher prices and rates.

The comparative analysis of the dynamics of incomes and the number of tourists for the two mentioned areas, which, in fact, are the main competitors in the global tourism market, is not without interest.



Graph 2.7.a. The comparative analysis of the income dynamics between Asia-Pacific and Europe.



Graph 2.7.b. The comparative analysis of the dynamics of the number of tourists between Asia-Pacific and Europe.

It is obvious that at the level of Europe, tourism (at least in terms of the input of "external" tourists) has major issues as long as at more than twice the number of tourists in relation to the Asia-Pacific area, the revenues of the the second zones are already higher than the revenues of the first zone (considering the year 2015), without adding that throughout the time horizon defined by the 20 years, the number of input tourists in Europe has was systematically and consistently much larger than the similar one in Asia-Pacific (sometimes reaching the ratio of 3.95: 1 – in 1995).

3. Conclusions

The complexity and size of the issues related to the globalization – tourism relationship exceed by far the scope of this study, which has led us to focus our analysis on a small but significant number of issues.

a. A first aspect that we believe to important is that, although the manifestation of economic crises or issues with a strong political and military burden in a certain region or another make their presence felt in the shortest time, globally, tourism represents one of the economic activities **with a great power of self-regeneration** and of the return to normal functional parameters. The causes of such behavior exist and deserve to be studied in more detail, precisely because of the motivation mentioned above – the capacity of self-regeneration.
b. We will not insist on the comparative analyzes of the type initiated above for reasons of space, but **we will emphasize another feature of the globalization of tourism**, namely that the errors made in a universalist utopian space, through promises and possibilities, are to be found only at the level of the national spaces, as projections of the concentrated (willfully or not) transfers of entropic type, because it is obvious that the national interest leaves a much more restricted room for maneuver and manifestations to the mistakes towards the universalist, globalist nothingness and it is also its responsibility, finally, to rebuild, restore and take over, only to be pushed back to other utopias of the same kind.
c. It should also be remembered that investments and the presence of foreign investors does not mean (if it ever meant) that we are "condemned to welfare", neither now nor later, for the simple reason that, for example, over 65% of the income coming from the tourism from the Mediterranean countries is poured into the "pockets" of some 10 companies from the tourist outgoing countries that either own or control corporate conglomerates that include air, naval and / or land transport operations, tour operators as well as accommodation objectives (hotels, motels, etc.).
d. Tourism cannot save a national economy but can help it survive (obviously not by itself). There is a strange rumour according to which tourism could become the economic pivot of one country or another, which is a false idea. The international statistics show, without a doubt, that where tourism holds a large or very high share of GDP, the sensitivity and status of the national economy is far from an acceptable optimum (we do not refer here to countries such as San Marino, Luxembourg, the Vatican, etc.).
e. Therefore, a much more thorough approach to the issue of tourism is needed among specialists, but especially at the governmental level. The capacity of the tourism to help support and, as the case may be, the return of a national economic space is directly and strongly dependent upon the legislative, material and governmental financial support. In this regard, it should be emphasized that, the size, quality and intensity of collaboration between the local, regional and national level is perhaps more important than the presence of foreign investors.
f. As stated from the beginning of this paper, tourism coexists in the global space since its emergence and **the globalism is the result of composing**

the dynamics and development of human activities and not vice versa. In the global space, tourism must act primarily as a factor of education and knowledge, perhaps not in the spirit of the ancients but not too far from them, as a factor of individual and national awareness and responsibility, and perhaps less as a temptation in corporatist financial style, of accumulation, possession and disposition at will, of the last and most devastating god: profit at any cost.

g. Previously, a series of stresses have been made regarding the capacity of tourism to recover quickly and for the general good or this capacity is seriously endangered by at least two of the basic characteristics of globalization:
   – the mimicry, as a vector of uniformization, undermining and systematic destruction of everything that is given as a specificity through traditions, culture, free spirit and geographic space that should be managed maybe in a more responsible way than in a sustainable way;
   – the "industrialization" and the transition to mass tourism has had and has devastating effects to the the tourism–man–nature relationship through the unlimited attack and depreciation of the natural environment without which one has no reason to speak of tourism, sustainable development, and so on.

h. On the one hand, in close connection with the aforementioned idea, according to which tourism could carry the task of reviving an entire national economy, the idea that all tourism would, after some, also be the panacea solution to more extensive endemic unemployment on economic spaces should be fought. Tourism, like any other self-sustaining economic branch from a managerial and administrative view point has its own specificities, its own rates of growth and development and by no means an infinitely elastic, but well-defined, capacity for instant absorption of manifest imbalances in the space of the national economy, in the absorption of the labor force and especially of any labor force. And it might not be uninteresting to underline the fact that, as a rule, this absorption capacity of the available labor force is lower as the foreign capital is present on the market.

i. On the other hand, although strongly dependent upon culture and traditions, thus being a more "conservative" area, tourism is open to (and sometimes it is even invaded by) new information technologies, especially in the area of marketing and public relations. For example, internationally, the first four major "tourism providers" are the US, Germany, Japan and the United Kingdom, which are countries that provide about 40% of the international number of tourists and over 80% of those who use the internet as a tool and source of tourism, information, reservation and payment.

We conclude these brief considerations on tourism and globalization by stating that if tourism has crossed, crosses and will cross all borders at all times,

not the same can be said of globalization which will always create new borders where it destroys the old, natural and historical borders. But this is an aspect that no longer has to do with tourism.

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RELEVANT ELEMENTS EVOLVING IN MOUNTAIN TOURISM

Abstract. *Tourism is the most dynamic area in the tertiary sector of services. It also includes elements of novelty, paradigm shifts and repositions of stakeholders in a very rapid evolution. This is the reason why we set ourselves on resuming ideas formulated in the last 5–10 years and watching how things have evolved in well-established basins.*

A survey was made of the mountain area of Neamț County and a recent diagnosis was made: investments in accommodation, public catering, community events, the impact of developments in sectors involved in chains (the value chain and the supply chain), how they evolve the agri-pastoral sector as a tourism provider, etc.

Interpretations and recommendations have been made in the context of the concept of "Innovation in Services" (supported by the European Commission)[4,5] *and "Mountains in the Horizon 2020" (EUROMONTANA Convention Initiative)* [6]*. The center of gravity of the paper is to explore the application of regenerative design for regenerative development.*

Keywords: *mountain tourism, tourist pool, tourism policies, tourist support services, regeneration.*

1. Introduction

The development of rural tourism has occupied much of the concerns of policy makers and development strategies and stakeholders. Things seemed easy because accommodation and dining were provided by the private environment, public access networks (roads) are done through national programs (which has not

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[6] https://www.euromontana.org/wp-content/uploads/2014/06/mountain_2020_ro.pdf, visited 4.04.2019

been confirmed); then, the objectives of attraction are classified and traced through the Ministry of Culture from Romania.

Depending on the seriousness of politics, the seriousness of entrepreneurs, the level of entrepreneurial spirit, the density of objectives on the territory of Romania, there are differentiated developments from one area to another on the background of a growing flow of tourists.

Tourism, and especially tourism rural, requires important innovation resources to meet the increasing demands of visitors. In addition, more and more complex communication paths are being diversified and lead to a strong investment challenge.

In this context, the majority of tourism entrepreneurs have understood that the engine of competitiveness must be permanently regulated by new and more suitable solutions. An IBM report from 2008 (IBM report, 2008)[7] reveals that the key ingredient of a successful management is the slogan "catch your client".

One of the most current solutions in tourism management is the integration of stakeholders. They aim to maximize profits, and are receptive to any favorable proposals. The integration process consists of:

- Switching from competition to collaboration in order to capture customers and quickly sell tourist packages;
- Correlation of investments through complementary actions so that the virtues of the supply chain can be highlighted;
- The conclusion of public-private partnerships for the same purpose, complementarity in the creation of market opportunities: cultural events, festivals, fairs, ad hoc events, development and maintenance of infrastructure.
- Calling on new and ingenious management and marketing methods.
- Business planning with a higher degree of predictability (linking the business plan – highlighting the feasibility of a business with the CANVAS business model – which highlights the success of the business).
- Highlighting all categories of land-related objectives that can be associated with tourism and can become attractions (natural, landscape, historical, cultural, spiritual, museums, collections, parks, etc.).

The challenge of the topic is to approach tourism in terms of the concept of "cultural ecosystem services".

It is known that ecosystems are study models of how to integrate man with nature, combine the biotope with biocenosis, integrate several domains and sectors into a harmonic correlation. Territorial boundaries of ecosystems are extremely variable and make biodiversity coexist with the aspirations of human comfort and well-being. In general, human aspirations act on the support of productivity and land exploitation to the detriment of natural processes that provide biological,

[7] http://globalforum.items-int.com/gf/gf-content/uploads/2014/04/ceostudy2008_fullrep.pdf, visited 19.06.2018

climatic, hydrodynamic stability. Restrictive correlations are made through the ecosystem to maintain supportability limits. The extension to "cultural ecosystem service" also brings viability and equity as principles of correlation, harmonization and interconditioning. So[8]:

- Suportability regulates the level of exploitation of natural resources without affecting the stability of regeneration mechanisms;
- Viability brings to the equation performance management defined by 4E: efficiency (impact-cost ratio); effectiveness (the ratio of what is being achieved to what is planned), economy (progressive reduction of costs from one series to another), effectiveness (own available and completed base for defining the scope of a business development project);
- Equity is the measure of alleviating the social tensions generated by the differentiated access to resources and the result of their valorisation.

Some examples of established ecosystems are:

- Anthropic ecosystem[9] = the natural environment in which man lives and works and where he exploits resources;
- Natural ecosystem[10] = the natural environment in which plants and animals live in a complex dynamic balance (biodiversity);
- Entrepreneurial ecosystem[11] = the business environment that orders businesses on the supply chain, value chain, and product lifecycle.

Meanwhile, things have evolved and tourism has been faced with a new challenge. The concept of sustainability, as defined in the 1987 Bruntland Report (World Environment and Development Commission), has reached its limits. There has been a phenomenon of degradation (erosion) of sustainability that causes degradation of ecosystems. Under these circumstances, the issue of tourism development must always be reassessed and reimbursed. This is how regenerative tourism emerged as a field of development and regenerative design (Pollock, 2019).

2. State of the art

The issue of human habitation has emerged as a component in the foundation of ecology since 1950 (Mang & Reed, 2012). Over time, architects have begun to notice a lack of arguments in designing habitat development projects and have become aware of the need to associate natural factors (Mang & Reed, 2012). Thus,

[8] https://www.futurelearn.com/courses/sustainability-society-and-you/0/steps/4618 visited 19.06.2018

[9] http://library.usmf.md/old/downloads/ebooks/Ecologia.umana/IV-Ecosisteme.umane.pdf , visited 19.06.2018

[10] https://ro.wikipedia.org/wiki/Ecosistem, visited 19.06.2018

[11] http://adrnordest.ro/user/file/news/Good%20Practice%20Report%20-%20Adrian%20 Healy % 20% 5BRO%5D%20OS.pdf, 2017, visited 19.06.2018

in 1969, the work "Designing With Nature" (McHarg, 1969) appeared in which the land was treated as a resource for ecological planning in the urban landscape. In the course of time, the relationship between man and nature has become more and more conspicuous, both positive and negative. Exploitation of land close to the supportability limit led to fertility exhaustion results even if sustainable exploitation attributes were met. In the 1980s, just before the Bruntland Report, the term "land regeneration" was used as the "injecting" solution for organic fertilizer intake. (Medard *et al*., 1985).

During the same period, J.T. Lyle elaborated the work "Designing Human Ecosystems" (Lyle, 1984), in which he grounded the idea that nature's design does not prepare for man as a passive tenant. Man and nature become partners. For this, not only the building but the surrounding ecosystem are shaping.

Once the idea of regeneration defined, a working group was set up, the Regenerative Design Center at Pamona Polytechnic University and deepened the concept by assigning its social, economic, ecological components. In 1996 a new leap is made, Lyle publishes a new handbook of manual value, (Lyle, 1994). The ideas here concentrate on the regeneration solution as a factor for the dynamism of the designed and executed ecosystem, so that it does not die but amplify and self-develop over time. In fact, the regenerative models, theoretically grounded, and the degenerative patterns that have occupied the plans of designers, architects and geographers for many centuries.

There was the question of completing them by association. In a first approximation the transition from the degenerative model to linear regeneration was made. First, an intermediate replacement stage with a regenerative (auto) system has been achieved, which has resulted in landscaping and power supply.

In the 1990s, the Regenesis collaboration group developed, which further developed the conceptual area of regeneration. An important step was the systemic approach. An ecosystem designed for development has several subsystems included. It is also part of larger systems (multi-level).

According to the concepts formulated and grounded by the Regenesis group[12], initiation in regenerative development begins before the regenerative design, because the designer and the beneficiary should not operate on a commercial service relationship but in partnership. In fact, the problem is mastered by a set of stakeholders who need to sustain sustainability through regeneration. Otherwise, a landscaping system is functional only as long as it is inhabited, then dies slowly and safely. Lyle (1994) proposed replacing linear flow systems with cyclic flux systems. This defines a new mechanism and ensures the continuous replacement of materials and energy used in operation.

Bailey (2002) states that "regenerative design solutions regenerate rather than deplete the systems and resources that underpin the support of life". They are generated by the uniqueness of the place and work to integrate the flows and

[12] http://www.regenesisgroup.com/articles.php, visited 08.05.2019

structures of the built and natural world. The scale of approach is important because, according to system theory, inter-cross interactions are created between levels.

Regenesis (2006)[13] defines four key prerequisites for framing regenerative approaches:

1. Location and potential; the territorial definition and the potential of resources that will be used in an evolutionary dynamics to achieve health and viability as a result of man's presence in that place are made. More plastic is called "power of the place"[14]. It's about systemic health. There are still limitations to the approach because focus is on man and not on the essence of the place. The place is something alive and forms in a system of a certain level composed in depth from several elements and subsystems, and on the positive axis it belongs to other more complex and complex systems. We are dealing with natural and cultural ecosystems with strong interactions. Natural ecosystems consist of: flora, fauna, climate, minerals, soil, waters, geological formations. Human ecosystems consist of: values, customs, traditions, economic activities, forms of civic association, forms of education, historical artifacts (Mang, 2001).
2. The regeneration capacity is an objective: there are 3 environments: built, natural, cultural. Man uses them and, based on them, tends to a higher level of life. There is a capacity threshold that needs to be developed and embedded to support their co-evolution (Reed, 2007). No built element polarizes the regeneration and the living that is created with it. It is important both how subsystems are aggregated and how they participate as a component in higher systems. There is a distinction between operational capabilities (systemic functional efficiency), organizational (how the environment is built and the design of its illumination to increase its value) and aspiration (integrating human aspirations into the effort to create health and generosity) (Lyle, 1994, Haggard *et al*., 2006).
3. Partnership with the place; it is the change that must take place in our mind (Haggard *et al*., 2006); it goes from a builder's work to a gardener's partnership with its place and its biological processes; the diversity of models, the connection experience (the basis of the partnership). Each element has been viewed as a system and has a matrix on which networks and relationships are built; they produce activities, developments, increases.
4. Progressive harmonization: it is intended to continuously increase the model's harmony between human and natural systems through dynamic and evolving processes. It is like a solar apex: regenerative projects have a steering resource that generates a lasting and mutually beneficial relationship

[13] http://www.regenesisgroup.com/pdf/Regenesis_Bibliography.pdf, vizitat 08.05.2019
[14] http://powersofplace.com/papers.htm, vizitat 08.05.2019

between human ecosystems and natural ecosystems in a specific place characterized by relevant, specific resources and processes.

Christopher A. *et al*. said: "When you build a thing, you can not build it in isolation. You have to fix the world around and from it so that the big world in that place becomes more coherent and comprehensive, and the thing you do is take place in the canvas of nature, as you do it" (Christopher *et al.*, 1997).

It follows from the above that: the first two premises establish the motivation of regeneration, and the other two provide the path to a regenerative process.

In practice, sustainable design takes 3 steps (© Regenesis Group):

– understanding the relationship with the place (design and realization of the anthropic construction). Integrative assessment: cultural, economic, geographic, climate, ecological) as living systems, which allows health and continuous evolution; it is significant the persuasion of the story that includes the essence of a place, how it fits into the landscape and the role of those who live in it (Mang & Reed, 2012).
– achieving harmony. This requires prior system design, integrated, optimized. Harmonizes the new building with the natural ecosystem and the cultural ecosystem, and has the health and productivity of the system.
– co-evolution. Functional sustainability is the result of harmonization of stakeholders for the continuity of the evolution of the integrated system into other systems. As early as the design phase, it is necessary to create a culture of co-evolution, of the system after the project has become reality, so as to prepare new social, economic, ecological opportunities to populate the living formats.

3. Developing the subject

If architects have set their own concepts for sustainable design and development, other categories of specialists have contributed to the development of the applicative part.

The design structure is the one described above and has led to two solutions for the time being. These are two areas that have at present exceeded their natural capacity and can be "planted" in natural and cultural ecosystems as regeneration resources

a. One of the directions is called permaculture (Marvick & Murphy, 1998), and consists of the "contraction of agriculture". Intelligence and technological gains in biology can make crops that produce a lot from a relatively small surface. Thus, a rural household can provide its food resources through this agriculture and intelligent biotechnology.
b. Another direction is the spectacular results of the last 10–15 years in the photovoltaic field, which has made a huge leap in efficiency in the process

of converting solar energy into electricity[15]. The placement of photovoltaic panels on buildings gives an extra function to the roofs, that of providing the necessary energy.

The balance of energy and materials becomes positive and allows accumulations or flows to the outside of the system, ensuring local vitality.

From the moment of availability of such resources one can think of using the excess of vitality for new levels of system life.

Until the application of the two attributes generating materials and energy, we must note the qualification of places for regenerative development. Every place has to go through the definition steps: viable, ecological, ecosystem, renewable. This can be done in several stages of sustainable design or in a single cumulative step. In the regenerative loop it is necessary to give life to the place. For this, the design should look at creating a natural environment where man finds his place. It is the opposite of conventional situations in which a special place for man is projected. Here is a very subtle game. If you design a natural place for man, it will disintegrate when the man leaves it. Conversely, if a natural place is projected, and man will adapt to live in it, nature will still function in the absence of man.

In order to apply the regeneration, it starts from an ecological place (where pollution problems have been solved and biologically compatible depollution solutions have been applied. For example water purification with macrophytes (Avădănei & Bucureşteanu, 2006). To ensure the regeneration conditions means to establish a balance between the generation and consumption of resources accompanied by a net increase in the conditions for improving the life (Moore, 2001). The second measure is to ensure social visibility and political transparency, for avoid the risk of undue ownership of the surplus (Howard *et al*., 2008).

A practical application of this theory has evolved into ecotourism. This has favorable elements of implementation, but also hostile elements, so a careful analysis of the way of integration has to be done.

Tourism is the most important service sector and highlights social and ecological response measures. On the other hand, on the social component, phenomena of cultural erosion are reported in terms of traditions, family, criminality. They are mainly due to the migration of the population in search of jobs and income, from the rural environment to the urban environment.

An attribute compatible with the theory of regeneration is that, apart from certain exceptions, tourism is temporary. This allows for the presence of man at certain time intervals. Some of the hosts are encapsulated and have only their own functioning attributes in limited spaces. The tourist phenomenon itself becomes a way of observing other worlds than the tourist's own world. It interferes with social and environmental conventions different from those in which it usually works.

[15] https://ro.wikipedia.org/wiki/Celul%C4%83_solar%C4%83, visited 10.05.2019

4. In fact research

In the spirit of the above, we have chosen a target area, a touristic pool with the best representation in the North East Region. It extends to the north of Neamt County in the watershed of the Ozana (Neamț) River and includes the town of Târgu Neamț as well as the communes Pipirig, Vânători-Neamț, Agapia, Bălțătești, Petricani, Raucesti.

We set out to make an assessment of the preparedness for the application of regenerative development as a support for sustainable tourism in this tourism field.

The development potential of tourism has found receptiveness in the area both from the private environment and from the local public administration. On the private side increased the number of accommodation units and accommodation places on an upward axis of comfort. Also, the number of public catering establishments has grown in refinement and diversity.

We did a traveling study in this area armed with two packets of questions:

- how do the local tourist dowry reappraise?
- how prepared is the population to apply the performing tourism models?

The touristic dowry of the Ozana Valley is particularly rich.[16] It can be mapped on a two-dimensional picture in two hypostases:

- the complexity and diversity of the objectives with tourism potential (Figure 1) and
- structures to support and encourage entrepreneurship in tourism (Figure 2).

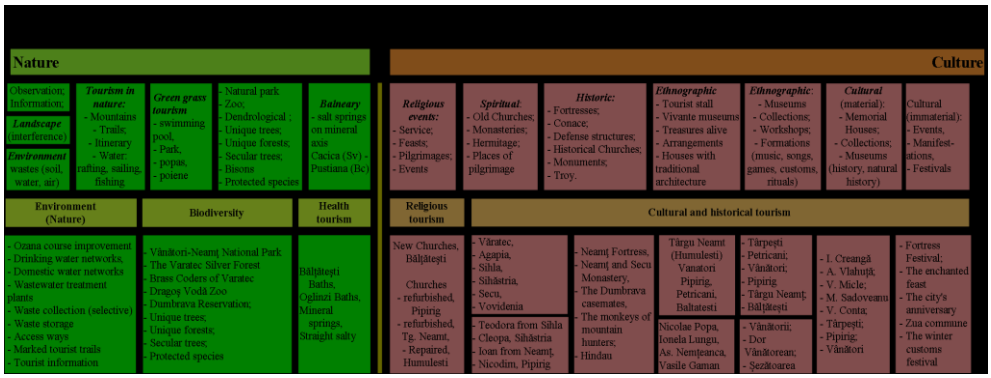

Fig. 1. Structure of tourist destinations in Ozana Valley.

It is remarkable and comments on this area as one of the richest and most diverse in the country, with unique elements, with a complex balance between nature and culture with a rich history and many, many resources.

[16] https://www.valeaozanei.ro/, visited 12.05.2019

Also, visibility in the tourist promotion world is a strong one with an impact on tourism consumers[17,18,19].

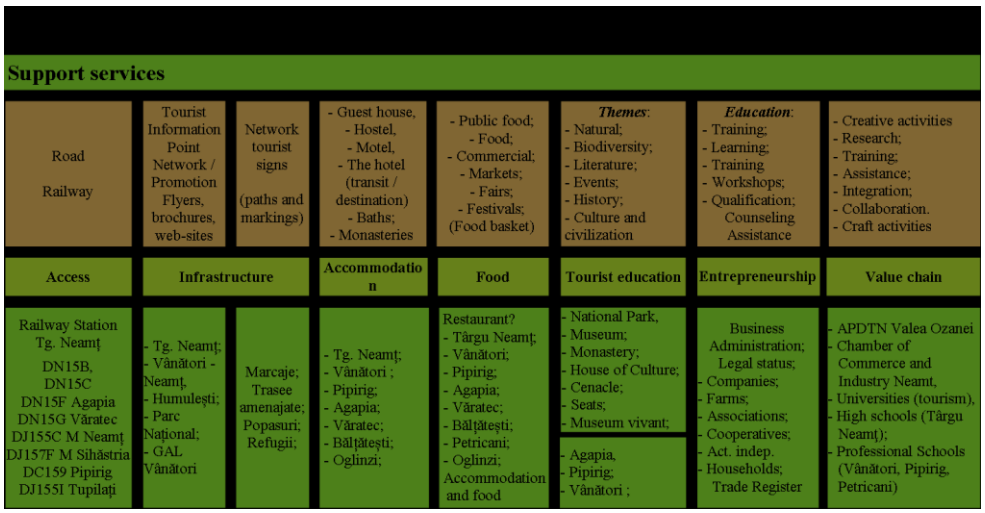

Fig. 2. Support structures for tourism in Ozana Valley.

In this context, we intend to assess to what extent the strategic construction of tourism in this area is ready to undertake revolutionary steps in supply and consumption. This is especially about the application of cultural ecosystem services concepts and sustainable design through regeneration.

There are a series of signals on ecotourism, but the steps taken in this direction are scarce and small. In particular, the issue of the use of renewable resources is deficient. Indeed, there are a number of roofs that host photovoltaic panels, there are thermal solar installations for domestic hot water supply, but their number is far below the critical threshold that would generate hopes. Heat agent for the cold season is still wood, although there are worrying signs about the depletion of this resource, given that the reforestated areas are very low.

Socially, there are important reasons for concern due to mobility. Young people leave the countryside to the urban environment or go abroad, and once they leave, they destroy the field's ability to preserve traditional culture. The questionnaires we have completed with the youngsters as well as the essays drawn up in relation to the culture of the villages of origin show that the career priorities and wage gains outweigh the "vibration of the ancestral values" signals (Avădănei *et al*., 2016). This is a sign that there is a process of eroding traditional culture and a

[17] http://www.viziteazaneamt.ro/tag/turism-neamt/, visited 15.05.2018
[18] http://www.tirguneamt-turistic.ro/obiective-turistice/ , visited 15.05.2018
[19] http://www.neamt.insse.ro/wp-content/uploads/2018/04/breviar-turism-Neamt-2017-web.pdf, visited 15.05.2018

desynchronization with aggravating trends in what is meant by "community force" and weakening the level of cohesion.

However, there are still elements that are currently strong in promoting traditional culture and how it is found in the cultural life of the Ozana Valley communities (Avădănei & Avădănei, 2016).

With regard to sustainable design, there are also serious desynchronizations due to the disproportionate and non-energy-related approach of house constructions, whether for residential or home use. The intense mobility among the population after Romania's accession to the European Union led to the adoption of models of really spacious houses; in relation to other climatic profiles and other solutions for the control of thermal flows in the warm and cold season. There are many villages that have homes that have started with exaggerated dimensions that could not be completed by the owners. Terminated turn out to be uninhabitable due to exaggerated energy consumption.

As far as constructions relations with nature are concerned, the distribution of living space in Ozana Valley is sufficiently adapted because at least in rural areas the environment is not perverted. Yet. In fact, in other regions of Romania (especially in Ranca), due to the construction of mountain roads, constructions with an architecture and a spatial conception unfit for a durable approach have appeared and expanded. At the same time there is an accelerated wave of pollution through the chaotic storage of garbage and other wastes (Ene, 2019).

In fact, the issue of solid waste has a strong shock wave wherever tourism development opportunities emerge. And the Ozana Valley is not exempt, although the mayors are making enormous efforts to ensure a clean environment that makes tourism attractive.

For the regeneration design stage, things are incipient:

- There is a concern to plan biodiversity within Vânători National Park (colonization of ants or bees, joining wood with other materials for residential buildings, capitalizing on local resources (especially forest fruits).
- The ZERO energy balance building concept is barely discussed theoretically, and only funding constraints on European projects produce "infiltrations" of photovoltaic panels;
- The principle of fractional extraction of energy from nature (especially in hydropower) begins to be strengthened by the partial capture of a watercourse (Atomei Gheorghe case in Târgu Neamţ, Blebea district).
- Vegetable garden initiatives in the balcony of the apartment are regarded as hobbies of hardships (in fact, here is the permaculture or the contraction of agriculture)[20].
- A good sign of regeneration is manifested by floral arrangements at hostels and monasteries (chosen at Agapia Monastery), where the floral world has a special impact on visitors.

[20] https://ro.wikipedia.org/wiki/Permacultur%C4%83, visited 13.05.2019.

It is expected that through the intervention of some entrepreneurial NGOs, the virtues of such organic farming practices and the production of photovoltaic energy will be disseminated in order to identify the first courageous entrepreneurs in terms of applying the principles of regeneration.

To address the regenerative tourism design, it is necessary to bring together several stakeholders within a community as the critical threshold for demonstrating viability is at the local level. First of all, it is the architects who can carry out the regenerative design through the General Urbanism Plan. Secondly, geographers who, using modern methods (GIS), assess the impact of regeneration on community development. Thirdly, urbanists and designers are drawn to implement the principles of local regenerative development.

Tourism is the first and most important beneficiary because it needs an element of continuity (in which the driving force is nature) to stabilize the hospitality landscape on fluctuating reception and overnight characteristics. The landscape must always keep its attractiveness characteristics in the presence and absence of man, and during the season (summer holidays or spring or autumn holidays) provide comfort and relaxation to tourists who will appreciate the efforts of the hosts.

Another important area of regeneration is agriculture; especially mountain farming. It is subject to thermal shock in spring and autumn. There is a high potential for growing crops by using smaller areas of land, but with more work and much more science. Here are involved ameliorative genetics, organic soil production, ecological treatments against diseases and pests, etc. Instead, the products made have a very clear almost permanent niche because the vegetables and fruits are formed, grow and bake in another spectral range generating bioactive compounds favorable to human health.

5. Conclusions

The regenerative approach is totally new and needs a change of mentality by a new paradigm of living and life in nature. Architects have already been told that they have to give up traditional rules in urban planning.

Tourism is the most spectacular application of regenerative design because it brings nature in the role of building a pleasant and healthy environment. It is also the solution for a positive balance in the production of renewable resources needed for sustainable development.

A possible solution for shortening the term of adoption of regenerative design comes from vocational and technical education on the following levels:

- Designing vocational and technical education specializations by formulating a self-employed purpose;
- Professional orientation correlated with the continuity mission within the community, but with performing means at school;
- Curricular foundation of the disciplines that ensure a positive balance of renewable resources in relation to the notoriety of the place; acquiring adequate skills;

- Professional orientation for skills in exploiting and capitalizing on renewable resources resulting from new sustainable design;
- Model of household and farm management favoring the application of the knowledge accumulated in the school;
- Sustainable rural household design in the context of the positive balance of renewable production.

The race for performing tourism in Ozana Valley continues with new public and private investments that ensure a natural environment favorable to the reception of guests. At the same time, it is a living environment, made with the help of architects who design a natural environment for nature, and man has to find his place in such an environment;

The operating steps in the regenerative design of tourism consist of: ● achieving the objective ● harmonizing with the exigencies and expectations of the beneficiaries ● participating in the natural-anthropic conjugal evolution in a friendly formula (Regenesis).

It is envisaged the adaptation of the "Zimbru Land" Strategy with elements of regenerative and sustainable design (Strategy, 2018) [21].

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AIR POLLUTION IN THE CONTEXT OF THE CIRCULAR ECONOMY IN SIRET-PRUT-NISTRU EUROREGION

Abstract. *As compared with other current societal, economic and political issues, environmental issues have long been neglected. In the context of the need for major changes, the circular economy can be a solution for changing the economic paradigm as well as a response to the reduction of air pollution. Health in the context of lucrative human activities is still second, but the solution could easily come through the transition to the circular model by providing clean air.*

The European Union has set itself the goal of achieving specific levels of air quality improvement, by reducing risks to the environment and human health since the 1970s, integrating more and more environmental protection requirements into European policies.

Thus, the present article tackles the sensitive issue of the air quality by revising the latest EU legislation in the matter, also linking it to a brief analysis of the air pollution in Siret-Prut-Nistru Eurozone (the part that belongs to the Republic of Moldova), and its connection with a series of economic and the health status of the population indicators in the period 2008-2017.

Key words: *euroregion, air pollution, economic and social implications.*

JEL: *Q01, Q53*

1. Introduction

The transition to a circular economy requires fundamental changes in production and consumption systems, far outweighing resource efficiency and recycling of waste. In the concept of circular economy, preserving the central role of products, preserving their value as much time as possible, places them at the center of the transition process. The current actions of stimulating and monitoring the transition focus primarily on materials, which is not surprising, as the circular economy's vision has evolved as a solution to the waste problem and current policies and business tools focus on waste or materials. Environmental issues such as biodiversity loss, water, air, soil pollution, both exhaustion and excessive use of resources and land are increasingly threatening society, and economic challenges such as supply risk, problematic structures deregulated markets and weak incentive structures lead to an increase in financial and economic instability.

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Air pollution and its impact on human health, ecosystems and biodiversity should be further reduced, with the long-term goal of not exceeding critical quantities and levels. To do this, efforts need to be stepped up in the field of air quality and to define relevant strategic objectives and actions for the post-2020 period.

In the Siret-Prut-Nistru Euroregion of Republic of Moldova (SPNERM), although the linear economy is deeply rooted, emerging trends indicate that the role of products in society is changing.

Moving to a circular economy requires a better understanding of the links between products, the underlying business model, infrastructure and societal governance that determine their lifecycle.

Monitoring and analysis conducted to identify key mechanisms and trends will be crucial in this respect. Generalizations must be avoided, however, because there is no universal solution for better product design for circular use.

2. The latest legislation of EU about clean air

In order to improve air quality, in latest decades, the EU was struggling to enforce requirements for environmental protection in energy, transport and industrial sectors. Thus, three main pillars of legislation (European Commission, 2018 and EEA, 2018) for clean air were projected: – Ambient air quality standards protecting environment and human health (EU, 2004 and EU, 2008), – Emission and energy efficiency standards for key sources of air pollution, – National emission reduction targets established in the National Emission Ceilings (NEC) Directive (EU, 2016).

Also, the European Commission adopted in 2013 a Clean Air Policy Package, including a Clean Air Programme for Europe (CAPE), (European Commission, 2013), aims to ensure full compliance with actual legislation until 2020. Also, the targets were set to further improve Europe's air quality, in order that by 2030 the number of premature deaths is reduced by half in report to the year 2005. Also, the CAPE was projected to track progress towards the Ambient Air Quality Directives objectives. In 2017, European Commission, regarding Ambient Air Quality Directives, started a two year process (until the 2019 ending) monitoring and assessment methods fitness for the period 2008–2018 but also and the extent to which have been facilitated action to prevent or reduce adverse impacts by the above directives.

In 2016, new directive for the limitation of the specific pollutants emissions of the medium combustion plants (EU, 2015) regulated pollutant emissions from fuels combustion with thermal input equal to or greater than 1 MWth and less than 50 MWth.

In 2018, for regional, national and local actors, the Commission adopted a communication with a more practical guidance – "A Europe that protects: Clean air for all". Member States are also supported by EU to meet their targets of clean air especially in urban areas by EU Urban Agenda and Urban Innovative Actions.

In addition, European Commission prioritises a strong Energy Union and committed also to accomplish the Paris Agreement on Decarbonisation targets, including by promoting electric cars.

The Republic of Moldova aims to integrate into the European Union by fulfilling the obligations stipulated in the Moldova-EU Association Agreement. In this respect, harmonization of environmental legislation is one of the main priorities and efforts are focused on the transposition of the acquis communautaire and directives on air quality, water, nature protection and biodiversity, waste, climate change, chemicals, mining, fishing etc.

3. Methodology

The article proposes a theoretical and a practical approach linking the air pollution to some economical and social indicators. At present, there are limited analyzes of the effects of air pollution, and in the Siret-Prut-Nistru Euroregion the empirical and applicative analyzes are still expected to be conducted. Thus, this article proposes a relatively simple but effective econometric approach to a better understanding of economic reality at the Siret-Prut-Nistru Euroregion of Republic of Moldova concening clean air. The approach is built on panel data with all the Moldova Siret-Prut-Nistru Euroregion districts or "rayons".

The database used is that of National Bureau of Statistics of the Republic of Moldova for the period 2008–2017. Also, for the analysis of the air pollution with CO_2 and SO_2 we used the statistical data from the period 2005–2014.

4. Results and commentaries

On the researches of National Bureau of Statistics of the Republic of Moldova for the period 2007–2017, we made an econometric analysis with some relevance to the air pollution. The results obtained are given below.

From the correlation matrix, the fertility rate is relatively fair (as expected) related to the regional air pollution indicator and the same thing we can say about genral population morbidity. Urban green spaces indicators do not correlate as how we expected with the air pollution indicator. This is due to the unsatisfactory evolution in the urban area of green space management.

If we consider that the increase and implicitly the increased value of industrial production causes air pollution, we can consider the evolution of the two indicators PSE and VIP as natural as possible.

Table 1

The correlation matrix regarding pollutant substances evacuation into air, total fertility rate, general population morbidity, the green spaces in urban area and value of industrial production on SPNERM

	PSE (Tones)	*TFR (Anbc)*	*GPM (pers. per 100000 pers.)*	*GSUA (Thousand m^2)*	*VIP (Mil. lei)*
PSE (Tones)	1				
TFR (Anbc)	-0.474	1			
GPM (pers. per 100000 pers.)	0.462	-0.197	1		
GSUA (Thousand m^2)	0.896	-0.510	0.501	1	
VIP (Mil. lei)	0.887	-0.519	0.512	0.962	1

Source: data from National Bureau of Statistics of the Republic of Moldova, authors' processing.
Notation: PSE – Evacuation of polluting substances in the atmospheric air by stationary sources of economic agents (Tones), TFR – Total Fertility Rate (Average number of born children of a woman on her entire fertile life), GPM – General Population Morbidity per 100000 pers (cases per 100000), GSUA – Green Spaces in Urban Area (Thousand square meters), VIP – Value of Industrial Production (Mil. Lei).

On the base of the above correlation matrix we can see that two elements can be considered causes and the other two effects. Thus, in Table 2 we can see that total fertility rate and general population morbidity in Siret-Prut-Nistru Euroregion of Republic of Moldova has a rather week R Square and Adjusted R Square (of 0.3664 and respectively 0.3627), but the p-value for the two indicators is well below 0.05, meaning that the model is well specified allowing for us to rejecte the null hypothesis H0. Only for TFR the coefficient is different significantly from 0, and the negative sign means that there is an inverse link between the pollution indicator and the total fertility rate analyzed.

Also on the base of the above correlation matrix (see Table 3) we can see that the alleged determinants of air pollution – the value of industrial production and the green spaces situation in urban areas have a small coefficients, not so different from 0. At the same time, the value of the determination coefficient (R2) 0.8109 is more than satisfactory and R2 adjusted 0.8097 at the level of 340 observations suggests a relatively strong correlation between the variables in the model. Thus, in Table 3 we can see that the p-value for the two indicators is well below 0.05, meaning that the model is well specified allowing for us to rejecte the null hypothesis H0 and to considered that the influence on PSE comes mainly from these factors. Only for GSUA the coefficient is rather different from 0, but the positive sign can mislead us. This is due to the relatively stagnant situation of green space management at urban level, so it is not surprising why air pollution is evolving in the same way as the development of urban green areas.

Table 2

The summary results of regression equation regarding pollutant substances evacuation into air and total fertility rate and general population morbidity, on SPNERM

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.6053							
R Square	0.3664							
Adjusted R Square	0.3627							
Standard Error	484.8164							
Observations	340							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	2	45812703	22906352	97.45435478	4.00025E-34			
Residual	337	79210831	235046.98					
Total	339	125023534						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1093.015378	266.09465	4.1076187	5.02294E-05	569.5996851	1616.4311	569.59969	1616.4311
TFR (Anbc)	-1304.152042	144.72693	-9.0111224	1.55212E-17	-1588.83399	-1019.4701	-1588.834	-1019.4701
GPM (pers. at 100000 pers.)	0.017664572	0.0020349	8.6808995	1.71087E-16	0.013661909	0.0216672	0.0136619	0.0216672

Source: Data from National Bureau of Statistics of the Republic of Moldova, authors' processing. Preserving above notations.

Moldova is a very vulnerable country to climate change. This becomes more dangerous if the Republic of Moldova is an agricultural country. One of the objectives agreed and declared in the field of climate change is to reduce the total emissions of greenhouse gases by 2020 by at least 25% compared to the base year 1990, by implementing economic mechanisms aimed at mitigating climate change, in accordance with the principles and the provisions of the United Nations Framework Convention on Climate Change. To solve this problem, the implementation of GD 1009/2014 in the Strategy for adaptation to climate change by 2020 is vital. Air quality is low in the Republic of Moldova. Although 6 air quality directives have been established, little progress has been made so far.

The Republic of Moldova emitted about 13.95 Mt CO_2 equivalent in 2015, which represents less than 0.04% of the total global emissions. According to the Two Biennial Report of the Republic of Moldova, the GHG emissions after 2015 have remained constant. The Republic of Moldova is committed to achieving by 2030 the unconditional target of 64–67% reduction of GHG emissions compared to the level of 1990 (reference year). The commitment to reduce greenhouse gas emissions could conditionally increase up to 78%, in the case of providing low-cost financial resources, technology transfer and multilateral technical cooperation, access to all of them being appropriate to the challenges of change.

Table 3

The summary results of regression eguation regarding pollutant substances evacuation into air and the green spaces in urban area and value of industrial production on SPNERM

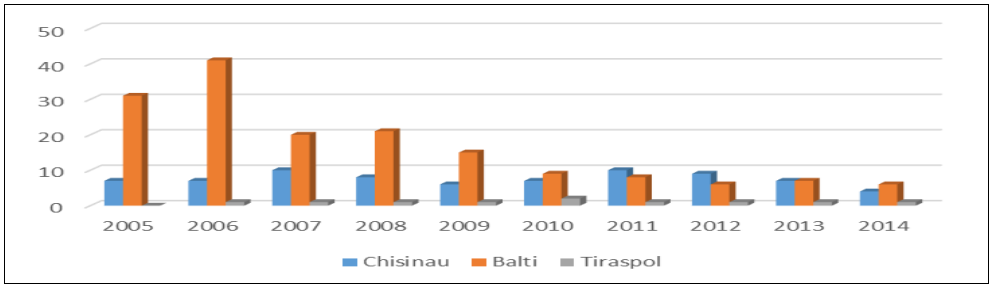
SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.9005065							
R Square	0.8109119							
Adjusted R Square	0.8097897							
Standard Error	264.85799							
Observations	340							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	2	101383068	50691534	722.61885	1.312E-122			
Residual	337	23640467	70149.753					
Total	339	125023534						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	274.32036	15.111716	18.152827	7.621E-52	244.5951886	304.045532	244.59519	304.04553
GSUA (Thousand m2)	0.5282537	0.0807553	6.5414106	2.264E-10	0.369405737	0.68710174	0.3694057	0.6871017
VIP (Mil. lei)	0.0558219	0.0141212	3.9530447	9.405E-05	0.028045034	0.08359883	0.028045	0.0835988

Source: Data from National Bureau of Statistics of the Republic of Moldova, authors' processing preserving above notations.

In terms of SO_2 pollution it has decreased over the years, the main sources are thermal power stations and small and medium boilers for coal burning in urban areas, the highest annual average concentration being recorded in 2006 in Balți – 41 μg / m^3 (Figure 1).

Moldovan cities in the Siret – Prut – Nistru Euroregion are facing a serious problem in the area of air quality monitoring. According to the data collected, the following substances are present in the air: sulfur dioxide, carbon monoxide, nitrogen dioxide, soluble sulphates, nitrogen oxide, phenol, formaldehyde. Using the current monitoring system will not allow us to control the implementation of transposed EU air quality directives. Also, the current data are not comparable at regional / European level.

Air quality is determined by air emissions from stationary sources and mobile sources (road traffic), predominantly in large cities, as well as long-distance transport of air pollutants.



Source: Data from National Bureau of Statistics of the Republic of Moldova

Figure 1. Average annual SO_2 concentration
for the cities of Chișinău, Bălți, Tiraspol

5. Conclusions

The circular economy, viewed in the context of sustainable development and, as one of the basic tools for achieving sustainable development, also as a means of efficiency of resources and energy, the application of cleaner technologies, with low carbon emissions and reduced pollution, and minimization of environmental risks.

The transition to a circular economy will create major economic opportunities. The "circularity" of the economy is a new growth engine, a generator of decent jobs and a vital strategy to eradicate poverty. This process can turn many challenges into economic opportunities and prevent the negative impact on the environment. Also, the circular economy will greatly increase economic growth and the number of jobs in the environmental sector that require specific environmental skills.

This process involves the modification of sustainable production and consumption patterns, and the change can be made through regulations, taxation, legal decisions and requests from the public, etc. In terms of sustainable production and consumption, in order to achieve the EU objectives, it is necessary to increase business responsibility and raise awareness of civil society, as Moldova continues to take the first steps in this area.

Integrating climate change and climate change adaptation issues into sectoral development policies and sustainable practices that need to be implemented at national and local level are essential to reduce pressures on policies and activities of other sectors on the environment and to achieve the following policy objectives, environment and climate.

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GLOBALIZATION EFFECTS ON ECONOMIC AND SOCIAL DEVELOPMENT OF SIRET-PRUT-NISTRU EUROREGION

Abstract. *At world level, the globalization process has undergone through different stages, existing visible contrasts between different geographical areas within the same country. Globalization is a complex, multifunctional phenomenon which consists of a wide range of social-human activities beginning with the internal market to the global one, with the economic and political dimension to the social one, with the internal right to the international rights and relationships, national-state sovereignty to globalization.*

In the year 2002 there got formed the euro-region "Siret-Prut-Nistru" including 18 districts from the Republic of Moldova and the counties of Iași and Vaslui from Romania. The partners of both countries have taken responsibility in terms of common European values such as economic and social development, democracy, promotion of cultural values and security insurance in this area. The euro-region strategy comprises developing directions of this one – economic, community development, localities' infrastructure development and environment protection for the next 15 years, respectively. In this context, the globalization level can be appreciated in terms of territorial subsystems are open and they provide access to those involved in as a whole.

Key words: *development, euro-region, globalization.*

JEL: *E7, M21, O1,O3*

1. The concept of globalization

Over the last decades, a series of radical changes occurred in the world economy have led to great debates especially on explosive growth of unemployment, uncontrolled rhythms of inflation, contradictory evolution of the process of economic integration, budget deficiencies, technological changes, competition intensification, environmental degradation, all together, being major problems which solution has not always been considered satisfactory. Economists have tried to find different solutions to these matters, but they have not succeeded in drawing relevant conclusions. [Constantinescu-Băeșu, 2005: 28].

Gradually the economic theory felt the need to use new concepts capable of explaining with a higher accuracy the great changes occurred recently in the world economy. One of these concepts which has brought significant contribution to the comprehension of the nature and all consequences of all these changes is exactly that of *economic globalization.*

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The literature frames different approaches of the globalization process. Next, five of these are going to be dealt with.

The first approach refers to globalization in terms of internationalization. From this perspective, "global" is merely another term to describe border relationships between states, and "globalization" means an increase of interdependencies and international trades.

The approach of globalization as internationalization is one of the most frequent ones. Thus, globalization refers to the increase of interactions and interdependencies between people from different countries. The significant growth of international trades over the last decades makes comprehensive why the term of *globalization* means internationalization. Globalization is related to the growth of interdependencies. This is exhibited mainly by the interdependence of markets which require the applying of globally coordinated and integrated strategy in order to face generalized competition [Bădulescu, 2000:22].

The second approach is the process of liberalization, which means a removal process of the restrictions imposed by authorities in terms of trades between countries in view of creating an "open", "border-free" world economy. In this context, globalization describes the process of economic integration; the proof of globalization understood as such may be found in a wide spread in the last decades of some practices of reduction and even annulment of trade barriers, of currency restrictions, capital controls and travel visas.

This definition identifies globalization with liberalization, the global world being a barrier-free one, without restrictions against the transfer of resources from one state to another. The last decades have known a multitude of reductions of official restrictions regarding the border movement of goods, money and financial instruments, thus one can explain the reason for which people associate globalization with liberalization.

The third approach of globalization defines universalization as "a planetary synthesis of cultures in a global humanism". In this context, "global" means "all over the world", and "globalization" is a process of spreading different experiences, objects, discoveries for peoples from all corners of the world [Reiser; Davis, 1994:25].

The fourth definition identifies globalization with occidentalization or modernization, especially in its "Americanized" form. According to this idea, globalization is dynamic because the social structures of modernity (capitalism, rationalism, industrialism, etc) are spread out all over the world, destroying by means of this process even the existing cultures and local self-determination. Globalization is sometimes described as an imperialism of Mc Donald's or Hollywood type, or merely colonialization.

The concept of modernization or "imperialism" is sufficient to express the idea of occidentalization, without requiring any other word [Bădulescu, 2000:24].

The fifth approach identifies globalization with the process deterioration (or as it is also named, a spread of over-territoriality). Globalization implies a

geographical reconfiguration so that the social space is no longer defined as territorial space, territorial distances or territorial borders. The significances of globalization are sometimes dealt with through the perspective of other coordinates such as distances: *Globalization is a process where geographical distances have ceased to be a determining factor in establishing the economic, political and social-cultural relationships*" [Luubers; Koodevar; 1998:1]. This definition includes both objective and subjective aspects of globalization. Although geographical distances are less relevant, globalization has gained power, force due to the fact that people have become aware of great possibilities created by new technologies and strategies.

The analysis of the concept of globalization as an increase of over-territoriality may be made by a fast review of the types of border activities in contemporary social and economic life. Such an endeavor emphasizes the idea that globalization has become a significant characteristic of contemporary society, though it does not influence the whole population in the same way and in the same extent.

As regards communications, for example, there has been achieved a wide range of over-territoriality connections, through aerial corridors, electromagnetic or light waves. Global communications give people the possibility of getting in touch ones with another, irrespective of territorial distances or borders. In the field of telecommunications, the telegraph, the telephone, the fax, the telex, the video-conference and computer networks allow text, signs, images and sound moving instantaneously, regardless of the space position or distances between people [Anghel, 2013:46].

In the context of globalization the market holds a special place. There is a global market when a product is sold and distributed in a world space by an over-territorially coordinated business strategy. In this way, consumers from all over the world buy simultaneously the same good or service, more often of the same brand. The so called "global factories", different stages of the globalization process are situated in different locations all over the Globe. Over-territoriality production involves the type of intra-firm trade within the global company as well as the trade between countries. By global sourcing, a producer gets the necessary production factors from everywhere on the globe. Over-territoriality production has mainly developed in the textile industry, auto vehicles, clothes, sport items, toys, electronic devices, optical equipment, building equipment and aeronautics [Bădulescu, 2000:34].

Globalization evolves in the financial area as well. Most transactions of currency exchange take place daily, every 24 hours, on world markets that connect the financial centers from big megacities. In the global bank world, economies in global currencies and/or global banks and/or local offices of global banks are being placed in [Anghel, 2013:53].

2. The role of globalization process in the development of Siret-Prut-Nistru Euroregion

Some authors define the process of globalization starting from an apparently easy question:

"what has this process of economy globalization brought about in terms of novelty?". Trying to answer it, the authors put on the first position the increase in interdependence showing that the events occurring in a country have got strong connection with those happening in other states in the world. Consequently, the globalization process has been considered as a long-term receiving and approaching modality or system of great contemporary problems, determined by the interaction of multiple economic, social, technologic, cultural, ecologic processes and phenomena [Dobrotă, 1998:228].

Globalization is susceptible of a variety of explanations. Some views mention the technological progress and entrepreneurship dynamics as forces of globalization, and others emphasize the role of legislation in premise demand and then in globalization guiding.

Cross-border cooperation subscribes for important polyvalent instruments that imply mobilization of financial resources as well in the framework of joint projects. Long term objectives of such projects aim at generating more bilateral advantages, improvement of physical and economic infrastructure, development of human resources of the region, reinforcement of cultural and educational relations, training in view of admission to the EU, environment protection [Roşcovan, 2003: 32].

The Euro-region Siret – Prut – Nistru, formed in 2002 is the "youngest" euro-region and includes the biggest number of administrative-territorial units of the three East border ones in Romania. The townships within the Euro-region Siret – Prut – Nistru belong mostly to those of a population below 5,000 inhabitants. The smallest ones, from the demographic point of view, are Cucuteni, Mădârjac, Bălteni, Bogdănița, Alexandru Vlahuță and Blăgeşti, having a population ranging between 1300 and 1700 inhabitants.

After the proclamation of independenceand acknowledgement by the international community, the Republic of Moldova has made considerable efforts in establishing international relations, getting admitted to international political and economic organizations, as well as in signing bilateral agreement with various countries. Being a small country, with limited natural resources, the Republic of Moldova cannot develop its economy unless it gets integrated in the European and world economic structures. In this sense, the efforts of getting integrated in the international community have been made both at central level and regional one by intensifying the cooperation between regional communities and similar structures from the neighboring countries, Romania and Ukraine [Roşcovan, 2003: 42].

The Republic of Moldova and Romania, as regards the level of collaboration between the border regions have evolved depending on the external politics of each state. Complex political and social-economic changes from theSouth- East Europe

have triggered this collaboration based on more factors, the most important ones being the following: [Roşcovan, 2003: 50]

- favorable geographical position. The Euro-regionsformed between these states are situated at the cross-roads of cross-national corridors which connect Central Europe states with those from Caucasusand Middle Asia, facilitating the transit of goods and persons;
- population and communities from the border regions are homogeneous from the point of view of linguistic unity, mentality, culture and traditions;
- reorientation of external politics of the Republic of Moldova towards the European Union by adopting the Plan of actions of the Republic of Moldova – European Union, organizing a series of meetings EU partners both in the Republic of Moldova and EU countries;
- EU extension towards East and the possibility of accessing EU funds and implementation of some cross-border projects in various fields (social, economic, environment, public administration).

The compounding factors of globalization are strongly related to each other and they cannot be clearly delimited as it is obvious from the figure below.

Source: Bran, F., Globalizarea şi mediul, Editura Universitară, Bucureşti, 2009, p. 47

Figure 1– Globalization Branches

Various aspects together with the process of globalization lead to a multitude of various cross-roads. It is important to see what subscribes to the concept of globalization. Equally important is the fact of understanding that not everything belongs to the process of globalization and one should take into accountthis aspect as well, because globalization has its own limits [Bran, 2009: 47].

Cross-border cooperation proves to be "a type of classical mutual cooperation between two border neighboring regions". This includes states, regions, and administrative units from different levels and/or social groups, covering all the fields of daily life and participating in the development of joint programmes, priorities and actions. Cross-border cooperation is favored by cultural inheritance, ethno-linguistic one, and historical one (see the case of national minorities). The common ethno-linguistic inheritance of the population of Romania and the Republic of Moldova is a favorable element in the process of cross-border cooperation. [http://transeco.ecosv.ro]

The cultural aspect of globalization promotes informing on the cultures that govern the Euroregion Siret – Prut – Nistru. Formed in the year 2002, the Euroregion Siret – Prut – Nistru consists of 18 districts of the Republic of Moldova and the counties of Iași and Vaslui from Romania.

The Republic of Moldova is a European country with a long history within the Romanian Moldova state (medieval and pre-modern), inhabited preponderantly by Moldavians (Romanian), but also by Ukrainian, Bulgarian, Russian, Jewish, German, Czech, etc.

The cultural patrimony of the Republic of Moldova is extremely rich and covers an ample area, of great value, including the national art, which continued to develop in the modern epoch providing the professional culture with the substance of its ethnic originality.In a great measure, the holidays in the Republic of Moldova and those in Romania are identical.

An important role in this process of cross-border cooperation is played by the local and regional administrative structures, by the developing associations and cross-border corporations interested in promoting a proper economic and political environment favorable to business development. To be successful, border areas should cooperate with cross-border partners from equal to equal and each part's interests involved in be respected.

As EU member country, Romania has to establish bilateral relationships with its neighbors but as well to apply the EU neighborhood policy versus the Republic of Moldova.

Globalization implies a very important aspect as well, that of politics. Political stability is one of the important factors that reinforce cross-border cooperation between two countries. The assistance for development provided by Romania to the Republic of Moldova has in view measures such as: [Bărbulescu, et al., 2016:70].

- Coordination with other instruments of external politics such as those related to political dialogue, commercial and economic relationships and so on;
- Increase in the impact and visibility of the Romanian assistance for development;
- Promotion and capitalization of the Romanian expertise of public institutions;

- Non-governmental organizations and those from the private environment;
- Foundation on carefully monitored and assessed results.

In the field of education besides the grant program of high school and university scholarships in Romania which has been developed for more than 25 years now, beginning with the year 2014, our country provides the Ministry of Education from the Republic of Moldova with methodologic assistance and expertise to reform the professional and technical education, to establish quality-assessment methodologies and standards forsecondary professional education and higher education [Bărbulescu et al., 2016:83].

Over the last years, the economic trades between Romania and the Republic of Moldova have improved significantly. Romania holds the first rank among the partner countries of the Republic of Moldova, both regarding imports and exports. The Romanian investments are mainly focused on the following areas: financial activities; trade; processing industry; property transactions and legal advice services.

On the whole, the objectives specific to cross-border cooperation within the Siret-Prut-Nistru Euroregion aims at: [Bărbulescu, et al., 2016:87].

- Development of business and SMEs
- Support for education, research, technological development and innovation
- Promotion of local cultures and preservation of historical patrimony
- Promotion of social inclusion and fight against poverty
- Support for good local and regional governance
- Environment protection, diminution and adaptation to climate changes
- Improvement of regions' accessibility, development of some transport networks and systems and long lasting communications
- Joint challenges in the field of safety and security
- Promotion and cooperation regarding energetic security and long lasting energy
- Promotion of border management and border security, mobility and migration management.

Globalization has also led to the change in the managerial model, in this context the manager being forced to keep acquainted with the innovations occurring at world level, with trends of market evolution and even with the developing perspectives of global competitors. In this new approach of globalization, the companies are eager to get involved in the process of staff training giving special attention not only to the recruitment and employment stages but also to that of integration of the new employees, their professional training according to the company's requirements.

In the new context of globalization the companies are eager to get actively involved in the process of staff training giving at present special attention not only to the recruitment and hiring stages but also to that of integrating the new

employees, of professional training according to the company's requirements. In conclusion, we may state that globalization is implemented by means of the solutions found by the global managers who take responsibility in local decision making and who take into consideration the consequences of their own decisions upon the whole environment of the company [Constantinescu-Băeșu, 2005:36].

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ANALYSIS OF GENDER QUOTAS IMPLEMENTATION FOR WOMEN EMPOWERMENT: EU AND REPUBLIC OF MOLDOVA'S EXPERIENCE[3]

Abstract. *Promoting gender equality and women empowerment has been one of the Millennium Development Goals of United Nations that nearly all world countries committed to achieve by 2015, including EU countries and Republic of Moldova. The slow progress towards this goal made it remain part of the UN agenda for the next 15 years. Due to that, it became necessary to analyze how an instrument like gender quotas can be used as some sort of last resort in this context in EU countries and in the Republic of Moldova. The purpose of the research is to analyze the experience of EU countries and Republic of Moldova on gender quotas as a tool for women empowerment and to see the opinions of employers and employees from Moldova on gender quotas. The research methods applied in the research include: legal analysis, induction and statistical analysis. The results of the survey on the opinions on gender quotas have shown that the views on gender quotas are mostly negative. Employers, even though recognizing their potential utility, have a pronounced reticence towards them, while opinions of employees were divided: some were optimistic and supported the idea, while others were sceptical that gender quotas have some potential for women empowerment and others pointed to other areas, like education, towards which more attention is needed for women empowerment.*

Key words: *decision-making position, employee, employer, gender quotas, international experience, Republic of Moldova.*

JEL: *J08, J7, J16, J83.*

1. Introduction

Gender issues have grown in media coverage together with human rights movements. They are part of feminism agenda the origins of which lie at the French Revolution. Since then four waves of feminism have passed. The first wave

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of feminism that lasted from XIXth century until the beginning of XXth century concerned itself with obtaining the right to vote and the right for married women to have property. The second wave (after 1960s) was focused on fully getting legal and social equality of women and men. The third wave feminism (since 1990s) emphasized the diversity, including the differences between women. The fourth and current wave (since 2010s) focuses especially in issues of sexual assault and empowering women. The movement for equal rights in employment began with the second wave feminism. Since equal rights didn't correspond necessarily to equal possibilities the feminist movement later focused on getting equal opportunities to work for men and women. In this regard gender quotas come as a regulatory pushing mechanism meant to foster women empowerment, not focusing on their rights, but on opening opportunities to make up for the discrepancies of policies on fostering gender equality. Therefore, inequality between men and women has been always an argued and controversial issue. This type of inequality appears in different areas of human activity, mainly within enterprises when applying for a job or in terms of wages, in politics – referring to the representativeness of men / women in elective bodies, in education, etc.

The aspects of gender quotas have been widely studied by a number of scholars from abroad, among which can be mentioned: Verge T. and Fuente M. [Verge & Fuente, 2014], Krook M. and Norris P. [Krook & Norris, 2014], Pesonen S. et al., [Pesonen et al, 2009], Terjesen S. and Sealy R. [Terjesen & Sealy, 2016], etc. In the Republic of Moldova, the issue on gender quotas has a different approach, being based mainly on the existence of quotas within the political system, rather than in the economic activity.

2. Applied research methods and materials

For the analysis of the gender quotas in Republic of Moldova the gender-wise data from the National Bureau of Statistics (NBS) of Moldova and from a survey about the perception of gender equality in the workplace conducted by the authors in the years 2018–2019 was used. 245 respondents from the Republic of Moldova took part in the survey, of which, by gender: the share of male respondents – 46.6%, female respondents – 53.4%; by age group: under 35 years old – 44.3%, from 35 to 50 years old – 32.1% and over 50 years old – 23.6%; by education level with higher education: licence/master degree – 57.3%, doctorate/postdoctorate – 42.7%; by activity sector: government sector – 59.2% of people, from private sector – 40.8% of respondents. Research methods that are applied in the scientific work include legal analysis of the laws of Republic of Moldova and EU about gender policies related to gender quotas, induction and statistical analysis of the NBS data.

3. EU experience of gender quotas

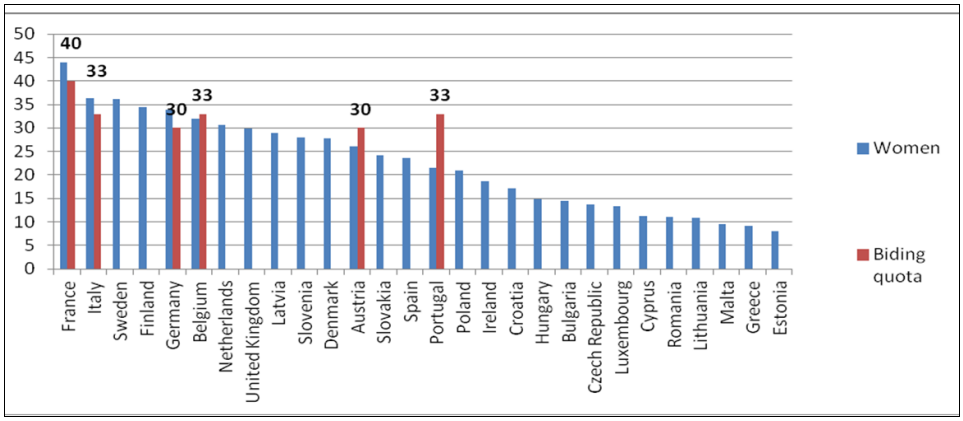
At the EU level, gender equality represents one of the fundamental values of the member states. The EU is dedicated not only to defending this right, but also to promoting gender equality within the Member States and across the world [Report, 2018: 7].

In order to enhance the issue of gender equality and increase the awareness of public opinion, business and politic environment on gender issues, the EU launched the Strategic Engagement for Gender Equality 2016–2019. Among the priority areas specified in the document can be mentioned the following ones: increasing female labour-market participation and the equal economic independence of women and men; reducing the gender pay, earnings and pension gaps and thus fighting poverty among women; promoting equality between women and men in decision-making; combating gender-based violence and protecting and supporting victims; and promoting gender equality and women's rights across the world [Strategic Engagement, 2015]. The key areas are essential for ensuring an equal treatment between men and women and erasing stereotypes related to the gender issues. At the same time, they will contribute in achieving the target set by the European Union of 75% of men and women engaged in job places and enhancing the involvement of women in participation on the labour market, thus diminishing the gap in employment.

Progress of these indicators has been monitored within annual reports dedicated to equality between men and women. Thus, the most recent report dated from 2019 [Report, 2019] presents the results of the EU's engagement for gender equality in terms of gender quotas. Express gender quotas within enterprises are not very established, except gender quotas for boardrooms, as women's position or representation within directory boards represents an important issue for the EU. Therefore, taking into account the third priority on promoting equality in decision making, the report mentions: "Despite some encouraging progress in recent years, the under-representation of women on corporate boards and in management positions remains an important challenge for EU Member States. This under-representation means that the potential of highly skilled and needed human resources remains untapped, as evidenced by the discrepancy between the high number of female graduates and their number in top-level positions. Women still face numerous obstacles on their way to reaching senior positions" [Report, 2019]. Thus, according to the latest data presented in the Report, the share of women involved in leading positions within the largest publicly listed companies registered in the EU Member States reached 26.7% in October 2018. With 44% of its board members being women, France is the only EU Member State with at least 40% of each gender at board level. In Italy, Sweden, Finland, and Germany, women account for at least one third of board members. In just under half of Member States (12), men still outnumber women by at least 4 to 1 (i.e. < 20% women). In Malta, Greece and Estonia, women account for less than 10% of board members.

The gender quota instrument has been introduced by many countries in various fields of activity in order to diminish the gap between men and women and increase the representativeness of a specific gender either in elective positions or in leading positions within enterprises.

Gender quotas within the boards of large companies from EU countries are established only in several countries. Thus, France has a targeted quota of 40%, Belgium, Italy and Portugal – 33%, Germany and Austria – 30%. These countries adopted a system of binding quotas. Other members of the EU have selected a different approach, mainly applying the quotas only in state-owned companies or no sanctions in case of non-appliance. On the other hand, Governments of such countries as Bulgaria, Czech Republic, Estonia, Croatia, Cyprus, Latvia, Lithuania, Hungary, Malta, Romania and Slovakia did not consolidate their efforts in order to obtain a progress in this field (see ***Figure 1***).



Source: European Institute for Gender Equality, Gender Statistics Database (2019), https://eige.europa.eu/gender-statistics/dgs

Figure 1. Share of women within the leading positions of the largest publicly listed companies from European Union, 2018, %.

Starting with 2010, the number of women in corporate boards has increased in many countries from the European Union. In Italy and France, the growth accounted for more than 30 p.p., while in Belgium and Germany this indicator reached more than 20 p.p. On the other hand, an insignificant progress has been registered in Croatia, Czech Republic and Hungary – less than 2 p.p. Negative progress has been registered in Lithuania (-2.3 p.p.) and Romania (-10.3 p.p.).

The issue of introducing gender quotas in politics has been widely debated for a long time. Therefore, member states of the EU have started to introduce step-by-step such a measure in order to increase women's participation in political life of the countries. In 2018, the presence of men is dominant in the legislative of every EU member state. On the other side, in terms of the representatives of

women in governments, France is on the leading position, having approximately 50% of representatives of both genders. Only three Member States have women as prime ministers: Germany, Romania and the UK. For the 2019 European elections, legislated quotas will apply in 11 countries (Belgium (the difference between the number of candidates of each gender should not be more than one), Greece (at least one-third of candidates from political parties must be with candidates of each gender), Spain (candidates of either gender should make up at least 40 per 100 of total membership), France (the difference between the number of candidates of each gender that a party or group of parties present for single-member constituency elections cannot be greater than 2%), Croatia (at least 40% of each gender), Italy (none of the two genders shall be represented in a percentage exceeding 60 percent), Luxembourg (quotas established at the party level, ranging from 33% to 50% for each political party), Poland (the number of candidates of each gender cannot be less than 35% of all candidates on the list), Portugal (a minimum representation of 33% of each gender), Romania (voluntary political party quotas, ranging from 25% to 30% of representation) and Slovenia (no gender shall be represented by less than 35% of the actual total number of female and male candidates on the list)) [Shreeves et al., 2019] [Gender, 2019].

4. Republic of Moldova's experience of gender quotas

Moldova ratified a series of international conventions on gender issues: the Convention on the Elimination of All Forms of Discrimination against Women (in 1994), ILO Convention on interdiction of Discrimination in Employment and Occupation (in 1996), ILO Convention on Equal Remuneration (in 2000). Through the *Government Decision No. 288 on the approval of the Millennium Development Goals in the Republic of Moldova until 2015 and the First National Report "Millennium Development Goals in the Republic of Moldova"* [Hotărârea, 2005] Moldovan Government approved Millennium Development Goals, one of which was to ensure gender equality and give women equal rights and opportunities. Extending women's participation in political and social life has been selected as a task for this goal. Various types of gender quotas have been selected as monitoring indicators: the share of mandates held by women in Parliament; leaders and senior officials from public administration authorities, economic and social organizations and the correlation between male and female wages.

4.1. Gender quotas in politics

At the end of 2009 a Government Decision was adopted regarding the approval of the National Program on ensuring gender equality for the years 2010–2015 [Hotărârea, 2009]. In the paragraph 63, this Decision proposes to operate with the harmonized set of gender-sensitive development indicators (60 types of indicators) in the context of the Millennium Development Goals, which were previously approved

by Decision No. 6 of the National Bureau of Statistics College on 26 December 2008. The performance and progress indicators that are included in the sphere of participation in the public and political decision-making process contain such indicators as: the share of mandates held by women in Parliament; the number/share of women and men, by residence areas, elected in municipal and local councils; the number of members of the Cabinet of Ministers by gender; the share of women in the number of civil servants in central and local public authorities; the number of managers and civil servants in functions of public dignity and economic units by gender and professional status (employees and non-employees). Following this Government Decision, a few laws were adopted or amended that introduced provisions of gender quotas in the public and political decision-making positions.

On February 9, 2006 the *Law on ensuring equal opportunities between men and women* [Legea, 2006] was adopted by the Parliament of Moldova, the purpose of which is to ensure the exercise of equal rights by women and men in the political, economic, social, cultural, other spheres of life, rights guaranteed by the Constitution of the Republic of Moldova, with a view to prevent and eliminate all forms of discrimination based on the gender criterion. The paragraph (2) of the article 7 of this law compel political parties to keep the minimum quota of 40% for both genders in providing representation in governing bodies and representation of women and men in lists of candidates without discrimination based on gender. The provision of gender quota was introduced in 2016 by the Law Nr. 71 from 14.04.2016 for amending and completing some legislative acts [Legea, 2016].

Based on the *Law on the amendment and completion of the Law no. 294/2007 on political parties* [Legea, 2018] political parties have the right to receive annual funding from the state budget through the Central Election Commission. The amount of the allowances for this purpose is approved in the annual budget law, with the percentage share representing no more than 0.2% of the state budget revenues, except for the special purpose revenues provided by the legislation. Political parties in proportion to the number of women effectively elected to the office of deputy in Parliament on uninominal circumscriptions can get 5% from the amount of allowances from the budget.

The paragraph (4) of the article 46 in the *Law on Electoral Code* of the Republic of Moldova [Legea, 1997] establishes that political parties that will respect the quota of at least 40% of candidates to be women submitted to uninominal circumscriptions shall benefit from an increase of the budget support of at least 10% of the amount allocated for the budgetary year of that party and a multiplication factor for each female candidate elected in the uninominal circumscription according to the legislation on political parties and procedure established by the Central Electoral Commission of the Republic of Moldova. The paragraph (1) of the article 86 in the same law stipulates that to be registered by the electoral council of the circumscription, the candidate for the uninominal circumscription presents subscription lists containing at least 500 signatures and up to 1000 signatures of the supporters with the right to vote in the uninominal circumscription where they intend to apply. By way of derogation from

this paragraph, a female candidate may be registered if she has signed at least 250 signatures and up to 500 signatures of the supporters with the right to vote in the circumscription where she is applying. The paragraph (6) of the article 46 of this law states that candidates' lists for parliamentary and local elections to be drawn up respecting the minimum representation rate of 40% for both genders.

Also, a mandatory minimum quota of 40% for both genders in the National Council of Participation is stipulated in the paragraph 11 of the *Government Decision on the Creation of the National Council for Participation* [Hotărârea, 2010], a condition introduced in 2012. The National Council for Participation is an advisory body, not a legal entity and was created as an expression of the will to recognize the value of the competences and to ensure the participation of the civil society and the private sector in the process development, implementation, monitoring, evaluation and review of strategic policy documents.

According to the article 27 of the *Law on the Government** from 31.05.1990 (which was abrogated in 2017) when Prime Minister of the Republic of Moldova forms the Government it should respect a minimum quota of 40% for both genders [Legea, 1990].

In the new *Law on the Government* from 07.07.2017 the article 10 states that when drawing up the list of candidates for the Government, the candidate for Prime Minister must take into account the legislation in the field of equal opportunities for men and women, correlated with the criteria of professionalism and merit [Legea, 2017]. Here the gender quota is not mentioned, while other criteria like professionalism and merit are stressed.

Based on the data of the Central Electoral Commission [Comisia, 2019] the mandatory gender quota for candidates' lists of political formations that was stipulated by law was respected by all the formations that participated in the general elections on February 24, 2019 (first elections after which the respective law entered into force), but the optional gender quota for circumscriptions lists of candidates, purely arithmetically, only 2 political formations from 11 in total respected the optional gender quota, but it can't be said for sure if this was a deliberate decision or not, since the number of candidates was very small (1 woman from a formation; 1 man and 1 woman from another formation).

Even if both genders have each a share of 50% in the list of candidates for elections, in other words, arriving at a mathematical equality between genders in this aspect, the higher positions of people of either gender on the lists privilege the people on these positions in the detriment of the people in the lower positions of either gender, thus inequality is not completely eradicated, because equality and inequality are abstract concepts and, thus, unattainable completely in concrete terms.

Now, let us suppose that an amendment has been made to current Moldovan legislation to enforce a minimum quota of 40% for both genders to corporate boards of all institutions. Before that, an analysis of the situation of decision-making positions in terms of gender needs to be done, based on available data. In 2017, the National Bureau of Statistics (NBS) of Moldova created the Gender Pulse platform wherein gender statistics are presented in an interactive way.

Among other data, the platform contains data about the share of women's and men's participation in decision-making positions (as members of the Parliament, in ministerial positions, as deputies in judiciary, in police service and as rectors of higher education institutions), which is shown in the ***Table 1.***

Table 1

Share of women and men in decision-making positions, %

		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Share of women and men as members of the Parliament	*Women*	20.8	24.8	25.7	19.8	19.8	19.8	18.8	21.8	20.8	21.8
	Men	79.2	75.2	74.3	80.2	80.2	80.2	81.2	78.2	79.2	78.2
Share of women and men in ministerial positions	*Women*	29.4	33.3	6.3	6.3	18.7	25.0	25.0	25.0	25.0	22.2
	Men	70.6	66.7	93.7	93.7	81.3	75.0	75.0	75.0	75.0	77.8
Share of women and men deputies in judiciary	*Women*	33.6	37.0	36.9	37.4	42.0	40.9	43.8	45.2	47.7	47.4
	Men	66.4	63.0	63.1	62.6	58.0	59.1	56.2	54.8	52.3	52.6
Share of women and men in police service	*Women*	9.1	8.9	9.2	9.8	17.9	18.3	17.1	17.4	17.9	18.8
	Men	90.9	91.1	90.8	90.2	82.1	81.7	82.9	82.6	82.1	81.2
Share of women and men as rectors of higher education institutions	*Women*	9.7	21.2	25.8	25.0	25.0	23.3	25.0	34.5	24.1	21.4
	Men	90.3	78.8	74.2	75.0	75.0	76.7	75.0	65.5	75.9	78.6

Source: developed by authors based on data of NBS from the GenderPulse platform [Aplicația, 2017]

According to the data from the ***Table 1*** for 2017, a position of women most close to the gender parity was present only between deputies in judiciary in which 47.4% were women. In the period 2008-2017, the share of women has grown with 13.8 p.p. with occasional small yearly reductions. The biggest growth of the share of women was between 2011 and 2012 (with 4.6 p.p.). The share of women as members of the Parliament didn't change too much during the period 2008–2017, oscillating around 20–25%. The share of women in ministerial positions during the period 2008–2009 was about 1/3, but in the next 2 years, 2010–2011 the share fell suddenly to 6.3%, while in the following years the share rose to 1/4. The share of women in police service was below 10% during 2008–2010; afterwards it doubled and didn't change significantly during the following years. The share of women as rectors of higher education institutions was below 10% in 2009, but in the following year it grew to 20–25% and it remained practically the same until 2017.

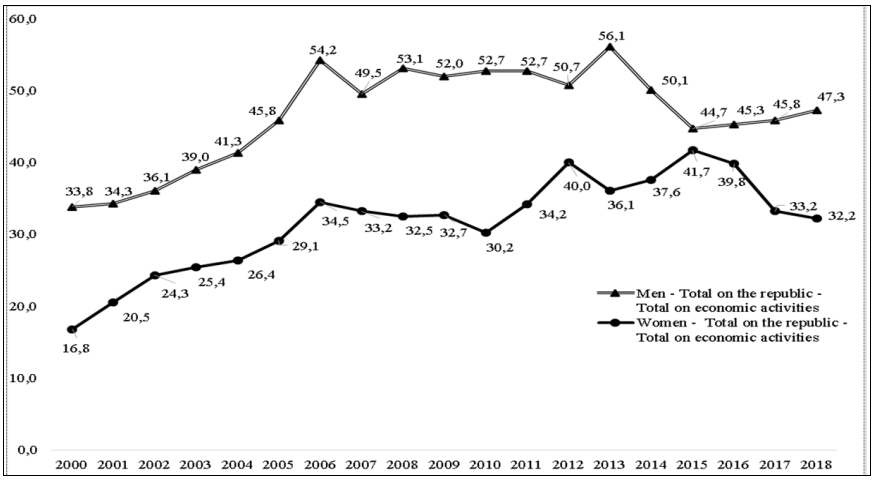
4.2. Gender quotas in economics

The *Law on ensuring equal opportunities between men and women* besides having provisions related to ensuring equal opportunities between women and men in the public domain, also has stipulations on ensuring equal opportunities between women and men in the social and economic domains (the articles 9–12^1). The law

contains general provisions for respecting gender equality, like banning: discriminatory information based on gender, refusal to hire motivated by familial obligations, unfounded refusal based on gender, unequal payment for equal amount of work, sexual harassment and other provisions that under-privilege people based on gender. Nevertheless, the law does not specify a concrete quota for either gender in decision-making positions in economic organizations.

The data from the National Bureau of Statistics will be used in order to observe the differences in the representation based on gender in decision-making positions. ***Figure 2*** shows the number of legislators, members of the executive, other senior dignitaries and officials of public administration, heads and senior officials of units, which include: legislators, executive members, other senior officials and heads of public administration; administrative and commercial managers; heads of industry and service units; heads of units in the hotel industry, commerce and other services. For the occupation the data are offered only in aggregate form.

The data from ***Figure 2*** show that there is a clear gap between men and women in decision-making positions; it narrowed in the period 2010–2015 following the active policies focused on gender equality, but from 2016 the gap began to increase, returning to values that were before 2010.



Source: developed by authors based on data of NBS [Biroul, 2000–2018]

Figure 2. The number of legislators, members of the executive, other senior dignitaries and officials of public administration, heads and senior officials of units by gender, total on economic activities in Republic of Moldova for the period 2000–2018, thousand persons

The gender gap between numbers of women and men in decision-making positions is larger in size in the organizations with private form of ownership than in those with public property as is seen in ***Table 2***. The gap in the public organizations during the period 2000–2018 doesn't get bigger than 6.0 thousand persons in the favour of women (in 2015) or smaller than – 3.8 thousand persons in the favour of

men (in 2000). The years 2011–2017 are a period in which there are more women than men in decision-making positions in public organizations. In contrast to these organizations, the gap between men and women in the private ones is considerably bigger. During the period 2000–2018 this gap oscillated from – 8.9 thousand persons in 2015 to – 21.1 thousand persons in 2009. In public organizations the shares of men and women in decision-making positions during the nearly entire period 2000–2018 was no less than 40% (like the electoral quotas). In contrast to public organizations in the private ones the shares of men and women in decision-making positions were more polarized. Women had around a third of positions and men – circa 2/3. In case of adopting a gender quota for decision-making positions in public institutions the quota is more or less respected, but in private organizations it's far from that. The data clearly show a predominance of men in private organizations in decision-making positions. The opinions of employers and employees on the gender equality in this aspect would create a fuller picture on this gap and on the necessity of gender quotas.

Table 2

The number of legislators, members of the executive, other senior dignitaries and officials of public administration, heads and senior officials of units by gender and by the form of ownership of the organization, total on economic activities in Republic of Moldova for the period 2001–2018 and the gap between women and men, thousand persons, %

	Men, thousand persons		**Women**, thousand persons		**The gap between women and men**, thousand persons		**The share of men***, %		**The share of women****, %	
	Pu_p	*Pr_p*	*Pu_p*	*Pr_p*	*Pu_p*	*Pr_p*	*Pu_p*	*Pr_p*	*Pu_p*	*Pr_p*
2000	12.0	18.1	8.2	6.7	-3.8	-11.4	59.4	73.0	40.6	27.0
2001	12.1	19.1	10.1	7.9	-2.0	-11.2	54.5	70.7	45.5	29.3
2002	11.7	21.3	11.3	10.4	-0.4	-10.9	50.9	67.2	49.1	32.8
2003	10.5	25.4	10.9	12.7	0.4	-12.7	49.1	66.7	50.9	33.3
2004	12.3	25.9	11.4	13.1	-0.9	-12.8	51.9	66.4	48.1	33.6
2005	14.1	29.1	12.0	14.7	-2.1	-14.4	54.0	66.4	46.0	33.6
2006	13.2	37.7	14.8	18.1	1.6	-19.6	47.1	67.6	52.9	32.4
2007	13.5	33.3	13.0	18.7	-0.5	-14.6	50.9	64.0	49.1	36.0
2008	13.5	37.4	13.7	17.3	0.2	-20.1	49.6	68.4	50.4	31.6
2009	12.1	37.0	14.8	15.9	2.7	-21.1	45.0	69.9	55.0	30.1
2010	12.7	35.6	12.6	15.3	-0.1	-20.3	50.2	69.9	49.8	30.1
2011	12.0	37.1	13.5	17.6	1.5	-19.5	47.1	67.8	52.9	32.2
2012	10.6	35.9	15.0	20.7	4.4	-15.2	41.4	63.4	58.6	36.6
2013	12.9	39.2	13.9	18.4	1.0	-20.8	48.1	68.1	51.9	31.9
2014	11.3	32.8	14.5	18.6	3.2	-14.2	43.8	63.8	56.2	36.2
2015	10.7	27.6	16.7	18.7	6.0	-8.9	39.1	59.6	60.9	40.4
2016	8.8	30.0	14.7	19.7	5.9	-10.3	37.4	60.4	62.6	39.6
2017	10.7	27.1	12.5	15.9	1.8	-11.2	46.1	63.0	53.9	37.0
2018	13.2	28.6	11.9	15.7	-1.3	-12.9	52.6	64.6	47.4	35.4

Source: developed by authors based on data of NBS [Biroul, 2000-2018]
Notes: Pu_p – public property, Pr_p – private property
*The share of men in the total number of persons in decision-making positions
**The share of women in the total number of persons in decision-making positions

4.3. Analysis of some results of a survey on the gender issues in employment done by the authors

In order to observe the attitudes of employees and employers on some aspects of gender issues in employment, including gender quotas, a questionnaire was created within the STCU Project #6336 "Innovative approaches to applied computations and software development for gender equality regulation on labour market" as a part of its marketing stage, being addressed to employees and employers from Moldova. The project's main objective is the creation of an electronic platform that will perform gender analysis automatically. Here, in this paper, analysis will be focused on some pertinent commentaries of some respondents on gender quotas, as they are seen in ***Table 3***. The majority of them have negative perceptions about gender quotas, stating that professional qualities may be overlooked while using the quotas. They may reduce the real capacity of employees, affecting work productivity, favour women against men without regard to merits as a form of positive discrimination, promote incompetence, demoralize men and create discontent and difficulties in the management of the company. Some respondents stated that gender quotas have a negative impact without mentioning the reasons for this. A respondent suggested that education represents a better tool for eliminating gender discrimination. Other respondents mentioned that applying gender quotas will make work more pleasurable since more women would work in the staff or that they help either gender to not be left behind.

Table 3

Commentaries on gender quotas from respondents

Respondents*	***Answers***
1	*"I will definitely resist their* [gender quotas'] *influence no matter how good is for women"*
2	*"First and foremost should be considered professional qualities"*
3	*"*[Gender quotas] *discriminate against men, promote incompetent women, complicate business management, reduce work productivity, demoralize men, generate discontent, diminish men's merits"*
4	*"It may weaken the real capacity of the workforce"*
5	*"It's more pleasurable to work"*
6	*"Eliminating discrimination is done through education"*
7	*"It is possible* [by using gender quotas] *to do more harm than good"*
8	*"I find it* [to be] *a form of positive discrimination"*
9	*"It ensures that no gender is left behind. As simple as that."*

Source: elaborated by authors based on data from the results of the survey

Notes: ***1** – Male employer, over 50 years old, from private sector, with licence or master degree, with a company where most of employees are men, who knows about the existence of gender quotas, who finds difficult to answer if gender quotas are applied at his company at employment and who considers gender quotas not capable of improving existing ratio between women and men in the management of the companies

2 – Female employee, over 50 years old, from state sector, with licence or master degree, from a company where women are predominant, who doesn't know about the existence of gender quotas, who finds difficult to answer if gender quotas are applied at her company at

employment and who considers gender quotas not capable of improving existing ratio between women and men in the management of the companies

3 – Male employee, 35–50 years old, from private sector, with doctorate or postdoctorate degree, from a company where nearly all are women, who knows about the existence of gender quotas, who says that gender quotas aren't applied at his company at employment and who considers gender quotas not capable of improving existing ratio between women and men in the management of the companies

4 – Female employee, over 50 years old, from state sector, with doctorate or postdoctorate degree, from a company where women are predominant, who knows about the existence of gender quotas, who finds difficult to answer if gender quotas are applied at her company at employment and who considers gender quotas not capable of improving existing ratio between women and men in the management of the companies

5 – Female employee, under 35 years old, from state sector, with doctorate or postdoctorate degree, from a company where the numbers of men and women are nearly equal, who doesn't know about the existence of gender quotas, who finds difficult to answer if gender quotas are applied at her company at employment and who considers gender quotas not capable of improving existing ratio between women and men in the management of the companies

6 – Male employee, 35–50 years old, from state sector, with doctorate or postdoctorate degree, from a company where women are predominant, who knows about the existence of gender quotas, who says that gender quotas are applied at his company at employment and who considers gender quotas not capable of improving existing ratio between women and men in the management of the companies

7 – Female employee, under 35 years old, from state sector, with doctorate or postdoctorate degree, from a company where the numbers of men and women are nearly equal, who doesn't know about the existence of gender quotas, who finds difficult to answer if gender quotas are applied at her company at employment and who considers gender quotas not capable of improving existing ratio between women and men in the management of the companies

8 – Female employee, under 35 years old, from state sector, with doctorate or postdoctorate degree, from a company where most of employees are men, who doesn't know about the existence of gender quotas, who says that gender quotas aren't applied at her company at employment and who considers gender quotas not capable of improving existing ratio between women and men in the management of the companies

9 – Female employee, under 35 years old, from private sector, with licence or master degree, from a company where women are predominant, who knows about the existence of gender quotas, who finds difficult to answer if gender quotas are applied at her company at employment and who considers gender quotas capable of improving existing ratio between women and men in the management of the companies

5. Conclusions

In the case of EU countries the issue of introducing gender quotas in politics was largely debated for a long period of time. As a result, EU states have started to introduce gradually such a measure in order to increase women's participation in political life of the countries. The results have a long way to go, because in 2018, the presence of men was still dominant in the legislative of every EU member state.

In the case of Republic of Moldova, although numerous laws have been adopted and many amendments related to gender policies have been made, there is still a significant gap between men and women in decision-making positions either in politics, economics or other areas. As members of the Parliament, in ministerial positions, in police service, as rectors of higher education institutions men have the

majority, while as deputies in judiciary the share of men and that of women are nearly equal. The gap between women and men with regard to the number of legislators, members of the executive, other senior dignitaries and officials of public administration, heads and senior officials of units total on economic activities in Republic of Moldova leans towards men, while it narrowed in the period 2012–2015 following the adoption of some legislative acts regulating gender issues in the context of the National Program on ensuring gender equality for the years 2010–2015, from 2016 the gap began to enlarge again. In the Republic of Moldova the share of men and that of women is nearly equal in the management positions in the public sector, while in the private sector, the majority (circa 2/3) of those positions are occupied by men.

Gender quotas can be seen as a last resort instrument to help women use opportunities to climb the social ladder, when the legal provisions for equal rights don't have the necessary effects in women empowerment. The fears of people towards gender quotas include: overlooking professional qualities, positive discrimination, reduced work productivity and real capacity of workforce, favouring incompetence, demoralization of men, generating discontent and complicating organization management, diminishing men's merits. Other people stated that applying gender quotas will ensure that either gender will not be left behind and gender discrimination can be eliminated through education. That being said, mentalities, stereotypes are strong factors for unused opportunity regardless of gender, being gender quotas used or not.

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