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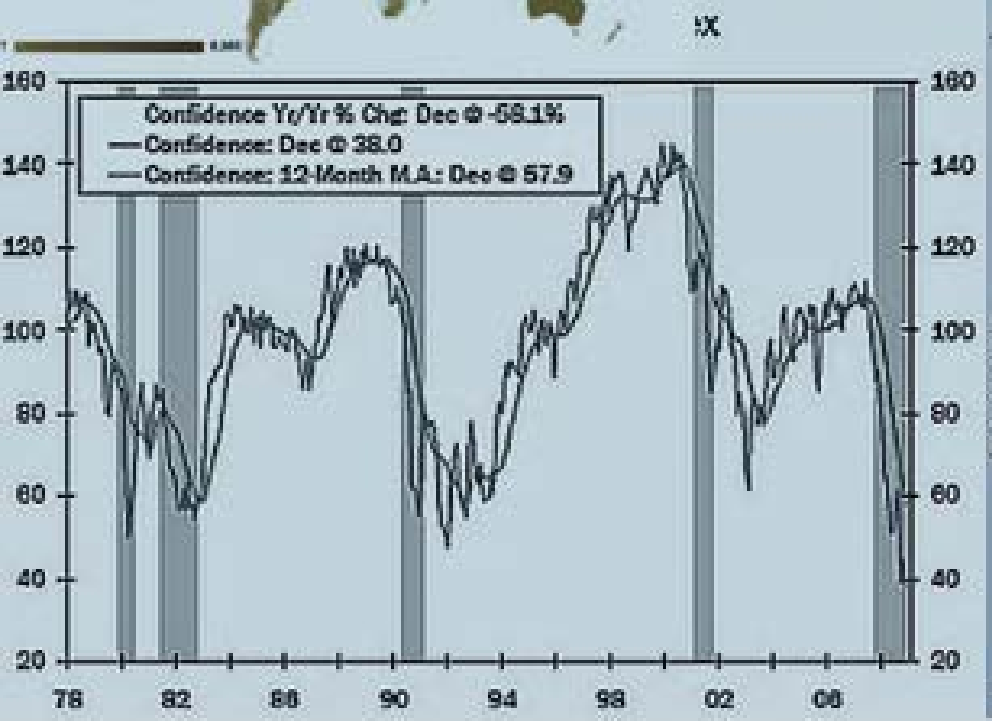

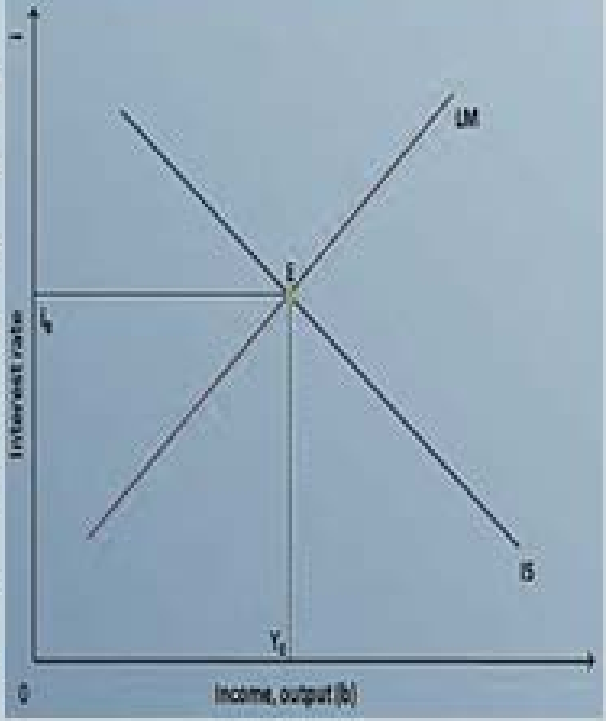

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CONTENTS

METHODOLOGICAL STUDY REGARDING THE CALCULATION OF STATISTICAL INDICES BY THE PROCESS OF SEPARATING THE ISOLATED ACTION OF EACH FACTOR AND THE PROPORTIONAL DISTRIBUTION OF THE INTERACTION OF THE INFLUENCING FACTORS

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ABSTRACT: *The methodological study presented in this article offers a solution of practical utility for substantiating decisions aimed at increasing the economic-financial performance of economic operators based on the identification and quantification of the factors that determined the size and modification of an indicator of strong representation of the activity carried out. The methodology presented in this study has a rigorous content, from a mathematical point of view, which respects a principle of calculation and proportional attribution of the influence of each factor that explains the change of a result indicator of the economic activity, synthetic or complex, obtained through sequential contributions but in the same unitary time of two or more factors with different degrees of importance. The general purpose of this methodology is to provide information unaffected by limited, particular principles, with justifications to which more or less pertinent counter-arguments can be brought. It is mentioned that there is the inconvenience of the complexity of the calculations, more difficult to achieve if a manual procedure is used, and a computer solution would be fully recommended.*

Keywords: *statistical index, influence factor, economic indicator*

JEL Classification: *C02*

1. INTRODUCTION

For the substantiation of decisions aimed at the management of economic activity, the **index method** is particularly useful due to the informational content provided by the statistical dimension called the index, obtained as a result of the comparison made in dynamic or static terms.

The statistical index is a relative quantity that expresses one of the following categories of states of economic phenomena:

- *dynamics,*
- *the degree of fulfillment of the programmed or planned indicators,*

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- the relative level of the proposed burden for the increase or decrease of an economic indicator in the following time segment,

- the size ratio between two economic indicators identical in terms of content and method of calculation, referring to two similar territorial entities (city, county, country) or two economic agents, but coexisting in time.

Therefore, the index is the result of the ratio of two statistical indicators referring to the same economic phenomenon, which, in turn, can be presented in absolute, relative or average form. The index expresses the relative change in the size of the indicator from the numerator compared to the size from the denominator of the ratio.

From the point of view of scope, two categories of statistical indices are distinguished: *individual, elementary or simple indices and group indices.*

The individual index expresses the size ratio between two statistical indicators that characterize collections of homogeneous units (objects or types of products) or phenomena with the same economic content. For example, one can calculate the individual index of the dynamics of the physical volume, the dynamics of the prices or the dynamics of the value of the goods sold by an economic agent for each type of goods, separately.

The general formulas for calculating the individual dynamics indices are:

- for a quantitative economic indicator (*f*),

$$i(f) = \frac{f_1}{f_0},$$

- for a qualitative economic indicator (x),

$$i(x) = \frac{x_1}{x_0}$$

- for a complex economic indicator (*Y*),

$$i^{(f)(x)} = \frac{f_1 * x_1}{f_0 * x_0}$$

The group index expresses the average relative change in the characteristics of a collection of units that differ from each other in terms of content or use value.

For example, the group index of the dynamics of the value of goods sold by a commercial company (the group index of the turnover dynamics), which is an index of a complex statistical indicator, is calculated as a ratio between the sum of receipts (value of sales) in the current period or calculation and the amount of receipts (value of sales) from the base period of comparison, according to the following relationship,

$$I^{(q)(p)} = \frac{\sum(q_1 * p_1)}{\sum(q_0 * p_0)}$$

in which,

"*q*" is the physical volume of sales by type of goods (economic indicator of quantitative type - *f*),

"*p*" represents the unit sale price for each kind of goods (economic indicator of qualitative type - *x*).

It is stated that both the physical volume of sales and the unit sales prices are not directly summable because they refer to different types of goods and consequently to highlight the separate influence or change of each of the two factors (*q* and *p*) are calculated factorial group indices by applying a certain weighting system.

Therefore, in the case of a factorial-deterministic relationship of the form $Y = f * x$, or $\sum y = \sum(f * x)$ to measure the separate change of each of the factors (quantitative - *f* and qualitative - *x*) that determined the change of the complex indicator (*Y*) or, in another form interpretation method, used only in the case of factorial group indices, to quantify the average change of the quantitative and, respectively, the qualitative indicator, the **method of successive**

substitutions (in a chain) is used, as a rule, but, in the analysis practice, other methods are sometimes used weighting methods: Laspeyres Index, Paasche Index, Logarithmic Weights Procedure (Fisher Index), Average Weights Procedure (Edgeworth Index), Finite Increases Procedure (Lagrange Index).

In order to systematize, generalize and rigorously apply the method of successive substitutions, the economic indicators are grouped as follows:

- ***quantitative economic indicators (f),*** such as: physical volume of production or services (*q*); average number of employees; the time worked by employees, expressed in man-hours; the time worked by employees, expressed in man-days; the average value of fixed assets; the average value of current assets; existing tourist accommodation capacity or the capacity built and intended for tourist accommodation; places-days capacity of existing tourist accommodation; places-days tourist accommodation capacity available, in operation or active; tourists staying in tourist accommodation units; the number of tourist days, etc.;

- ***qualitative economic indicators (x)***: production price or tariff per physical unit of services; retail price; labor costs incurred on average with one employee; full unit cost; the specific consumption of material and energy resources expressed in natural units; expenses per 1000 lei turnover; financial return rate; labor productivity; the average number of rotations of current assets, the average duration in days of a rotation of current assets and in general all indicators expressing economic efficiency;

- ***complex economic indicators (Y)***: turnover; commercial margin; exercise output; added value, total expenses; total revenues; total labor costs; total expenses with raw materials, materials and energy related to the productive activity, trade or service provision; the total consumption of raw materials, materials and fuel expressed in natural units - by types of resources; operating result; the net result of the financial year, the gross result of the year.

The application of the method of successive substitutions implies compliance with the following two basic rules:

1) *the individualization and dimensioning of the influence of a quantitative factor that determined the change of the complex indicator is carried out by weighting (keeping it constant) with the qualitative factor as a basis for comparison*;

2) *the individualization and dimensioning of the influence of a qualitative factor that determined the change in the complex indicator is carried out by weighting with the compared quantitative factor.*

We make it clear that, in the case of the analysis by influence factors of the indicators that characterize the efficiency of the use of direct or primary production factors (labour force, fixed assets and material circulating assets or material and energy resources), consumed to obtain an economic result, the indicators of economic effect are treated as qualitative indicators, and those of economic effort have the meaning and behave as quantitative indicators.

The general calculation formulas used in the case of the method of successive substitutions, when we want to quantify the respective changes in relative and absolute quantities, are the following:

- the total change of the complex phenomenon (indicator):

Index,

$$I^{(f)(x)} = \frac{f_1 * x_1}{f_0 * x_0}, \text{ or } I^{(f)(x)} = \frac{\sum(f_1 * x_1)}{\sum(f_0 * x_0)}$$

The related absolute change,

$$\Delta = f_1 * x_1 - f_0 * x_0, \text{ or } \Delta = \sum(f_1 * x_1) - \sum(f_0 * x_0)$$

from which:

- the influence of the change in the quantitative type factor (*f*):

Index,

$$I(f)=\frac{f_1*x_0}{f_0*x_0}\text{, or } I(f)=\frac{\sum(f_1*x_0)}{\sum(f_0*x_0)}$$

The related absolute change,

$$\Delta(f) = f_1 * x_0 - f_0 * x_0\text{, or } \Delta(f) = \sum(f_1 * x_0) - \sum(f_0 * x_0)$$

- the influence of the change in the qualitative type factor (*x*):

Index,

$$I(x)=\frac{f_1*x_1}{f_1*x_0}\text{, or } I(x)=\frac{\sum(f_1*x_1)}{\sum(f_1*x_0)}$$

The related absolute change,

$$\Delta(x) = f_1 * x_1 - f_1 * x_0 \quad \text{or } \Delta(x) = \sum(f_1 * x_1) - \sum(f_1 * x_0)$$

to check the equalities:

$$I^{(f)(x)} = I(f) * I(x)$$
$$\Delta = \Delta(f) + \Delta(x)$$

2. REFERENCE LITERATURE

Methodological study regarding the calculation of statistical indices through the process of separating the isolated action of each factor and the proportional distribution of the interaction of influencing factors joins the numerous methodological substantiation works that have been presented in articles and specialized papers from the country and abroad.

All the studies we refer to are based on the logic of basing the statistical approach on economic theory. The methods and procedures of statistical processing of statistical information data, the particular cases that aim at the size, structure and dynamics of economic variables, as well as the formation of interdependence relationships between them, are described distinctly.

In this sense, the works that describe the statistical methodology for calculating and interpreting statistical indices, the informational significance of the results, published by Andrei Tudorel, Statistics and econometry, Economic Publishing House, Bucharest, 2003[1], are relevant; Baron T., Biji E., Tövissi L., Wagner P., Isaic-Maniu Al., Korka M., Porojan D., Theoretical and economic statistics, Didactic and Pedagogical Publishing House, Bucharest, 1996[2]; Calot G., Cours de statistique descriptive, DUNOD Publishing House, Paris, 1965[3]; Desabie, J., Theorie et pratique des sondages, Statistique et programs economiques, Volume 10, DUNOD Publishers, Paris, 1966[4]; Isaic-Maniu Al., Mitruț Constantin, Voineagu Virgil, Statistics for business management, Economic Publishing House, Bucharest, 1995[6]; Mihăilescu, N. - "Statistics and Statistical Bases of Econometrics", Transversal Publishing House, Bucharest, 2021[8]: Mills F. C., Statistical Method, Columbia University Press, New York, 1956[9].

A specialized application treatment refers to the factor analysis of the dynamics of complex indicators which is presented by Mihăilescu, N. in the paper - "Analysis of the economic-financial activity - Research methodologies, solved case studies for the substantiation of economic-financial decisions and knowledge tests" , Transversal Publishing House, Bucharest, 2021[7].

The mentioned works present, in the context of scientifically based methodology, from an economic point of view, statistical studies to express the reality of economic processes with dynamic development or in a static profile.

3. THE METHOD OF SEPARATING THE ISOLATED ACTION OF EACH FACTOR WITH DISTRIBUTION PROPORTIONAL TO THE INTERACTION OF INFLUENCING FACTORS (METHOD OF PROPORTIONAL INCREASES)

Another methodological procedure used to calculate the influence of the factors that determined the change of a complex indicator is known as the ***"Method of separating the isolated action of each factor".***

The application of the principle of separating the individual action of the factors that determine the modification of a complex indicator - presented as a function of two or more influencing factors, according to a factorial-deterministic relationship - is based on a weighting system that invariably uses the basic indicators of comparison, regardless of whether they are of a quantitative or qualitative nature. It results, in this case, and an additional influence which is caused by the interaction of factors or the simultaneous action of factors.

The process of separating the isolated action of each factor leads to the amplification of the volume of calculations, especially when the number of factors that determined the change of the complex indicator is greater than two. To demonstrate this fact, we present the following diagram:

Table 1. The number of statistical indices and related absolute changes in the case of the Procedure of separating the isolated action of each factor

The number of factors	Index synthetic	The number of indices of isolated influences	The number of factor interaction indices						
2 factor	C_2^0	C_2^1	C_2^2						
The number of indices	1	2	1	1					
3 factor	C_3^0	C_3^1	C_3^2	C_3^3					
The number of indices	1	3	3	1	4				
4 factor	C_4^0	C_4^1	C_4^2	C_4^3	C_4^4				
The number of indices	1	4	6	4	1	11			
5 factor	C_5^0	C_5^1	C_5^2	C_5^3	C_5^4	C_5^5			
The number of indices	1	5	10	10	5	1	26		
6 factor	C_6^0	C_6^1	C_6^2	C_6^3	C_6^4	C_6^5	C_6^6		
The number of indices	1	6	15	20	15	6	1	57	
7 factor	C_7^0	C_7^1	C_7^2	C_7^3	C_7^4	C_7^5	C_7^6	C_7^7	
The number of indices	1	7	21	35	35	21	7	1	120

Note on exemplifying the calculation of the number of combinations,

$$C_3^1 = \frac{3!}{1! * (3-1)!} = \frac{1 * 2 * 3}{1 * 1 * 2} = 3$$

$$C_5^3 = \frac{5!}{3! * (5-3)!} = \frac{1 * 2 * 3 * 4 * 5}{1 * 2 * 3 * 1 * 2} = 10$$

It is noted, thus, the important increase in the typology of factors' interaction indices as the number of indicators considered as influencing factors increases. It is also noted that the influences expressed by the indicators of the interaction of the factors (simultaneous action of the factors) present difficulty for interpretation, and consequently their dimensions are to be distributed over the specified factors, using a criterion of proportionality, thus we have the image of complexity the calculations involved with the application of the procedure of separating the isolated action of each factor.

Exemplification of the calculation methodologies will be carried out in the variants that present the complex indicator according to two influencing factors and respectively three influencing factors between which there is a multiplying relationship.

Case 1 – Complex indicator with two influencing factors: *"a"* and *"b"*

- the synthetic index (complex indicator index),

$$I = \frac{a_1 * b_1}{a_0 * b_0} \text{ and}$$

- the absolute change of the complex indicator,

$$\Delta = a_1 * b_1 - a_0 * b_0$$

- indices of the isolated influences of factors *"a"* and *"b"*

a) $$I^{(a)} = \frac{a_1 * b_0}{a_0 * b_0} \text{ and}$$

- the related absolute change,

$$\Delta^{(a)} = (a_1 - a_0) * b_0 = \Delta(a) * b_0$$

b) $$I^{(b)} = \frac{a_0 * b_1}{a_0 * b_0} \text{ and}$$

- the related absolute change,

$$\Delta^{(b)} = (b_1 - b_0) * a_0 = \Delta(b) * a_0$$

- the index of the interaction of factors *"a"* and *"b"*

$$I^{(a)(b)} = \frac{a_1 * b_1}{a_1 * b_0} \div \frac{a_0 * b_1}{a_0 * b_0} = \frac{(a_1 * b_1) * (a_0 * b_0)}{(a_1 * b_0) * (a_0 * b_1)} \text{ and}$$

- the related absolute change,

$$\Delta^{(a)(b)} = a_1 * b_1 - a_1 * b_0 + a_0 * b_0 - a_0 * b_1 = \Delta(a) * \Delta(b) = (a_1 - a_0) * (b_1 - b_0)$$

The recurrence relation between indices (multiplicative format)

$$I = \frac{a_1 * b_1}{a_0 * b_0} = I^{(a)} * I^{(b)} * I^{(a)(b}$$

The recurrence relation between the absolute changes (additive format)

$$\Delta = a_1 * b_1 - a_0 * b_0 = \Delta^{(a)} + \Delta^{(b)} + \Delta^{(a)(b)}$$

After the proportional distribution of the change caused by the interaction of the factors, the factor influences expressed in absolute numbers are:

- the influence of factor "*a*",

$$\Delta^{(a)} = (a_1 - a_0) * b_0 + \frac{(a_1 - a_0) * b_0}{(a_1 - a_0) * b_0 + (b_1 - b_0) * a_0} * \Delta(a) * \Delta(b)$$

- the influence of factor "*b*",

$$\Delta^{(b)} = (b_1 - b_0) * a_0 + \frac{(b_1 - b_0) * a_0}{(a_1 - a_0) * b_0 + (b_1 - b_0) * a_0} * \Delta(a) * \Delta(b)$$

- the proportionality coefficient of the isolated influence, determined by the change in the "*a*" factor,

$$Ka = \frac{(a_1 - a_0) * b_0}{(a_1 - a_0) * b_0 + (b_1 - b_0) * a_0}$$

- the proportionality coefficient of the isolated influence, determined by the change in the "*b*" factor,

$$Kb = \frac{(b_1 - b_0) * a_0}{(a_1 - a_0) * b_0 + (b_1 - b_0) * a_0}$$

Case 2 – Complex indicator with three influencing factors: "*a*", "*b*" and "*c*"

- the synthetic index

$$I = \frac{a_1 * b_1 * c_1}{a_0 * b_0 * c_0} \text{ and}$$

- the absolute change of the complex indicator,

$$\Delta = a_1 * b_1 * c_1 - a_0 * b_0 * c_0$$

- indices of the isolated influences of factors "*a*", "*b*" and "*c*"

$$I^{(a)} = \frac{a_1 * b_0 * c_0}{a_0 * b_0 * c_0} \text{ and}$$

- the related absolute change,

$$\Delta^{(a)} = (a_1 - a_0) * b_0 * c_0 = \Delta(a) * b_0 * c_0$$

b) $I^{(b)} = \frac{a_0 * b_1 * c_0}{a_0 * b_0 * c_0}$ and

- the related absolute change,

$$\Delta^{(b)} = (b_1 - b_0) * a_0 * c_0 = \Delta(b) * a_0 * c_0$$

$I^{(c)} = \frac{a_0 * b_0 * c_1}{a_0 * b_0 * c_0}$ and

- the related absolute change,

$$\Delta^{(c)} = (c_1 - c_0) * a_0 * b_0 = \Delta(c) * a_0 * b_0$$

- indicators of the interaction of factors

1. the interaction of factors "a" and "b"

$$I^{(a)(b)} = \frac{a_1 * b_1 * c_0}{a_1 * b_0 * c_0} \div \frac{a_0 * b_1 * c_0}{a_0 * b_0 * c_0} = \frac{(a_1 * b_1 * c_0) * (a_0 * b_0 * c_0)}{(a_1 * b_0 * c_0) * (a_0 * b_1 * c_0)}$$

and the related absolute change,

$$\Delta^{(a)(b)} = (a_1 * b_1 * c_0) - (a_1 * b_0 * c_0) + (a_0 * b_0 * c_0) - (a_0 * b_1 * c_0)$$
$$= (a_1 - a_0) * (b_1 - b_0) * c_0 = \Delta(a) * \Delta(b) * c_0$$

2. the interaction of factors "a" and "c"

$$I^{(a)(c)} = \frac{a_1 * b_0 * c_1}{a_0 * b_0 * c_1} \div \frac{a_1 * b_0 * c_0}{a_0 * b_0 * c_0} = \frac{(a_1 * b_0 * c_1) * (a_0 * b_0 * c_0)}{(a_0 * b_0 * c_1) * (a_0 * b_0 * c_0)}$$

and the related absolute change,

$$\Delta^{(a)(c)} = (a_1 * b_0 * c_1) - (a_0 * b_0 * c_1) + (a_0 * b_0 * c_0) - (a_1 * b_0 * c_0) =$$
$$= (a_1 - a_0) * (c_1 - c_0) * b_0 = \Delta(a) * \Delta(c) * b_0$$

3. the interaction of factors "b" și "c"

$$I^{(b)(c)} = \frac{a_0 * b_1 * c_1}{a_0 * b_1 * c_0} \div \frac{a_0 * b_0 * c_1}{a_0 * b_0 * c_0} = \frac{(a_0 * b_1 * c_1) * (a_0 * b_0 * c_0)}{(a_0 * b_1 * c_0) * (a_0 * b_0 * c_1)}$$

and the related absolute change,

$$\Delta^{(b)(c)} = (a_0 * b_1 * c_1) - (a_0 * b_1 * c_0) + (a_0 * b_0 * c_0) - (a_0 * b_0 * c_1) =$$
$$= (b_1 - b_0) * (c_1 - c_0) * a_0 = \Delta(b) * \Delta(c) * a_0$$

4. the interaction of factors "a" , "b" and "c"

$$I^{(a)(b)(c)} = \left[\frac{a_1 * b_1 * c_1}{a_0 * b_1 * c_1} \div \frac{a_1 * b_1 * c_0}{a_0 * b_1 * c_0}\right] \div \left[\frac{a_1 * b_0 * c_1}{a_0 * b_0 * c_1} \div \frac{a_1 * b_0 * c_0}{a_0 * b_0 * c_0}\right] =$$

$$= \frac{(a_1 * b_1 * c_1) * (a_0 * b_1 * c_0) * (a_0 * b_0 * c_1) * (a_1 * b_0 * c_0)}{(a_0 * b_1 * c_1) * (a_1 * b_1 * c_0) * (a_1 * b_0 * c_1) * (a_0 * b_0 * c_0)}$$

and the related absolute change,

$$\Delta^{(a)(b)(c)} = (a_1 * b_1 * c_1) + (a_0 * b_1 * c_0) + (a_0 * b_0 * c_1) + (a_1 * b_0 * c_0) - (a_0 * b_1 * c_1)$$
$$-(a_1 * b_1 * c_0) - (a_1 * b_0 * c_1) - (a_0 * b_0 * c_0) = (a_1 - a_0) * (b_1 - b_0) * (c_1 - c_0)$$
$$= \Delta(a) * \Delta(b) * \Delta(c)$$

The recurrence relation between indices (multiplicative format),

$$I = \frac{a_1 * b_1 * c_1}{a_0 * b_0 * c_0} = I^{(a)} * I^{(b)} * I^{(c)} * I^{(a)(b)} * I^{(a)(c)} * I^{(b)(c)} * I^{(a)(b)(c)}$$

The recurrence relation between the absolute changes (additive format),

$$\Delta = a_1 * b_1 * c_1 - a_0 * b_0 * c_0 = \Delta^{(a)} + \Delta^{(b)} + \Delta^{(c)} + \Delta^{(a)(b)} + \Delta^{(a)(c)} + \Delta^{(b)(c)} + \Delta^{(a)(b)(c)}$$

After the proportional distribution of the changes caused by the interaction of the factors with the changes calculated by the isolated substitution of each factor, the factor influences expressed in absolute numbers (derivative procedure in additive format) are:

- the influence of factor "*a*",

$$\Delta^{(a)} = \Delta(a) * b_0 * c_0 + \frac{\Delta(a) * b_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(a) * \Delta(b) * \Delta(c) + \\ + \frac{\Delta(a) * b_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0} * \Delta(a) * \Delta(b) * c_0 + \frac{\Delta(a) * b_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(a) * \Delta(c) * b_0$$

- the influence of factor "*b*",

$$\Delta^{(b)} = \Delta(b) * a_0 * c_0 + \frac{\Delta(b) * a_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(a) * \Delta(b) * \Delta(c) + \\ + \frac{\Delta(b) * a_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0} * \Delta(a) * \Delta(b) * c_0 + \frac{\Delta(b) * a_0 * c_0}{\Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(b) * \Delta(c) * a_0$$

- the influence of factor "*c*",

$$\Delta^{(c)} = \Delta(c) * a_0 * b_0 + \frac{\Delta(c) * a_0 * b_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(a) * \Delta(b) * \Delta(c) + \\ + \frac{\Delta(c) * a_0 * b_0}{\Delta(a) * b_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(a) * \Delta(c) * b_0 + \frac{\Delta(c) * a_0 * b_0}{\Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(b) * \Delta(c) * a_0$$

The exposed methodology has a rigorous content that respects a principle of calculation and proportional attribution of the influence factors that explain the change of an economic activity result indicator, synthetic or complex, obtained through sequential but at the same time unitary contributions of two or more factors with different degrees of importance. The general purpose of this methodology is to provide information unaffected by limited, particular principles, with justifications to which more or less pertinent counter-arguments can be brought.

It is mentioned that there is the inconvenience of the complexity of the calculations, more difficult to achieve if a manual procedure is used, and a computer solution would be fully recommended.

- **Case study, demonstrative**

It is mentioned that in order to make a convenient demonstration, the derivative procedure will be applied in additive format and the statistical data that will be used are conventional. The complex indicator ("*Y*") under analysis is presented as a product of a number of three influence factor indicators,*"a*", *"b*" and *"c*".

Table 2 The system of statistical data on the dynamics of the "*Y*" indicator and influencing factors "*a*", "*b*" and "*c*".

The name of the indicators		Base period (Measurement units – m.u.)	Calculation period (Measurement units –m.u.)	Dynamics indices
The complex indicator		$Y_0 = a_0 * b_0 * c_0 = 90$	$Y_1 = a_1 * b_1 * c_1 = 192$	2,13333
Factorial indicators	*a*	3	4	1,33333
	b	5	6	1,20000
	c	6	8	1,33333

The total absolute change of the complex indicator, in the calculation period compared to the base period, is given by the following relationship:

$$\Delta = a_1 * b_1 * c_1 - a_0 * b_0 * c_0 = 192 - 90 = 102,$$ from which :

- the isolated influence of the indicator (factor) "*a*"

$$\Delta^{(a)} = (a_1 - a_0) * b_0 * c_0 = (4 - 3) * 5 * 6 = +30$$

- the isolated influence of the indicator (factor) "*b*"

$$\Delta^{(b)} = (b_1 - b_0) * a_0 * c_0 = (6 - 5) * 3 * 6 = +18$$

- the isolated influence of the indicator (factor) „*c*"

$$\Delta^{(c)} = (c_1 - c_0) * a_0 * b_0 = (8 - 6) * 3 * 5 = +30$$

- simultaneous influence of indicators (interaction of factors) **„*a*" and „*b*"**

$$\Delta^{(a)(b)} = (a_1 - a_0) * (b_1 - b_0) * c_0 = (4 - 3) * (6 - 5) * 6 = +6$$

- simultaneous influence of indicators (interaction of factors) „*a*" and „*c*"

$$\Delta^{(a)(c)} = (a_1 - a_0) * (c_1 - c_0) * b_0 = (4 - 3) * (8 - 6) * 5 = +10$$

- simultaneous influence of indicators (interaction of factors) „*b*" and „*c*"

$$\Delta^{(b)(c)} = (b_1 - b_0) * (c_1 - c_0) * a_0 = (6 - 5) * (8 - 6) * 3 = +6$$

- simultaneous influence of indicators (interaction of factors) „*a*", „*b*" and „*c*"

$$\Delta^{(a)(b)(c)} = (a_1 - a_0) * (b_1 - b_0) * (c_1 - c_0) = (4 - 3) * (6 - 5) * (8 - 6) = +2$$

After applying the procedure for distributing the interjection of the factors, the result is:

- the influence of the factor **„*a*",**

$$\Delta^{(a)} = \Delta(a) * b_0 * c_0 + \frac{\Delta(a) * b_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} * * \Delta(a) * \Delta(b) * \Delta(c) + \frac{\Delta(a) * b_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0} * \Delta(a) * \Delta(b) * c_0 + + \frac{\Delta(a) * b_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(a) * \Delta(c) * b_0 = =30 + \frac{30}{30+18+30} * 2 + \frac{30}{30+18} * 6 + \frac{30}{30+30} * 10 =$$

$$=30.00000+0.76923+3.75000+5.00000=+39.51923$$

- the influence of the factor „*b*",

$$\Delta^{(b)} = \Delta(b) * a_0 * c_0 + \frac{\Delta(b) * a_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} *$$
$$* \Delta(a) * \Delta(b) * \Delta(c) + \frac{\Delta(b) * a_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0} * \Delta(a) * \Delta(b) * c_0 +$$
$$+ \frac{\Delta(b) * a_0 * c_0}{\Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(b) * \Delta(c) * a_0 =$$
$$= 18 + \frac{18}{30+18+30} * 2 + \frac{18}{30+18} * 6 + \frac{18}{18+30} * 6 =$$

$$=18.00000+0.46154+2.25000+2.25000=+22.96154$$

- the influence of the factor „*c*”,

$$\Delta^{(c)} = \Delta(c) * a_0 * b_0 + \frac{\Delta(c) * a_0 * b_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} *$$
$$* \Delta(a) * \Delta(b) * \Delta(c) + \frac{\Delta(c) * a_0 * b_0}{\Delta(a) * b_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(a) * \Delta(c) * b_0 +$$
$$+ \frac{\Delta(c) * a_0 * b_0}{\Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} * \Delta(b) * \Delta(c) * a_0 =$$
$$= 30 + \frac{30}{30+18+30} * 2 + \frac{18}{30+30} * 10 + \frac{30}{18+30} * 6 =$$

$$=30.00000+0.76923+5.00000+3.75000=+39.51923$$

To calculate the factorial influences that determined the change in the complex indicator, the following proportionality coefficients were used:

1) for the distribution of the interaction of the factors *”a*”, *”b*” şi *”c*”

- the proportionality coefficient of the isolated influence, determined by the change of the factor *”a*”,

$$K(a)bc = \frac{\Delta(a) * b_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} = \frac{30}{30+18+30} = 0{,}384615$$

- the proportionality coefficient of the isolated influence, determined by the change of the factor *”b*”,

$$Ka(b)c = \frac{\Delta(b) * a_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} = \frac{18}{30+18+30} = 0{,}230769$$

- the proportionality coefficient of the isolated influence, determined by the change of the factor *”c*”,

$$Kab(c) = \frac{\Delta(c) * a_0 * b_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0 + \Delta(c) * a_0 * b_0} = \frac{30}{30+18+30} = 0{,}384615$$

2) for the distribution of the interaction of the factors *”a*” and *”b*”

- the proportionality coefficient of the isolated influence, determined by the change of the factor*”a*”,

$$K(a)b = \frac{\Delta(a) * b_0 * c_0}{\Delta(a) * b_0 * c_0 + \Delta(b) * a_0 * c_0} = \frac{30}{30+18} = 0{,}625$$

- the proportionality coefficient of the isolated influence, determined by the change of the factor*”b*”,

$$Ka(b) = \frac{\Delta(b)*a_0*c_0}{\Delta(a)*b_0*c_0+\Delta(b)*a_0*c_0} = \frac{18}{30+18} = 0{,}375$$

3) for the distribution of the interaction of the factors *"a"* and *"c"*

- the proportionality coefficient of the isolated influence, determined by the change of the factor *"a"*,

$$K(a)c = \frac{\Delta(a)*b_0*c_0}{\Delta(a)*b_0*c_0+\Delta(c)*a_0*b_0} = \frac{30}{30+30} = 0{,}500$$

- the proportionality coefficient of the isolated influence, determined by the change of the factor *"c"*,

$$Ka(c) = \frac{\Delta(c)*a_0*b_0}{\Delta(a)*b_0*c_0+\Delta(c)*a_0*b_0} = \frac{30}{30+30} = 0{,}500$$

4) for the distribution of the interaction of the factors *"b"* and *"c"*

- the proportionality coefficient of the isolated influence, determined by the change of the factor*"b"*,

$$K(b)c = \frac{\Delta(b)*a_0*c_0}{\Delta(b)*a_0*c_0+\Delta(c)*a_0*b_0} = \frac{18}{18+30} = 0{,}375$$

- the proportionality coefficient of the isolated influence, determined by the change of the factor *"c"*,

$$Kb(c) = \frac{\Delta(c)*a_0*b_0}{\Delta(b)*a_0*c_0+\Delta(c)*a_0*b_0} = \frac{30}{18+30} = 0{,}625$$

The total absolute change of the complex indicator: +102.00000 monetary units.
from which:

- the influence of the factor *"a"*: +39.51923 monetary units.
- the influence of the factor *"b"*: +22.96154 monetary units.
- the influence of the factor *"c"*: +39.51923 monetary units.

Based on these results, the following findings are identified:

- the complex indicator registered an increase in the calculation period compared to the level of the base period by 2.1333 times, respectively by 102,000 m.u;
- factor "*a*" caused the increase of the complex indicator "*Y*" by 39.51923 m.u. respectively by 38.744%;
- factor "*b*" justifies the increase of the complex indicator "*Y*" by 22.96154 m.u. respectively by 22.511%;
- factor "*c*" caused the increase of the complex indicator "*Y*" by 39.51923 m.u. respectively by 38.744%;

Note: A customized situation for a complex indicator like "*Turnover*", the following functional relation, *Y =f(a,b,c)*, can be written:

*Turnover (Y) = Stock turnover rate expressed in number of turnovers (a) * Proportion of stocks in the value of current assets (b) * Value of current assets (c)*

It is specified that the value of stocks and respectively the value of current assets are calculated as average values related to a period of time for which the turnover was recorded.

Case 3 – Complex indicator with four influencing factors: "a", "b", "c" and "d",

Example of a demonstrative calculation with conventional statistical data where the complex indicator Y is in a determining relationship with four factorial indicators (Method of proportional increases – additive variant)

Base period: $Y_0 = a_0 \cdot b_0 \cdot c_0 \cdot d_0 = 3 \cdot 5 \cdot 7 \cdot 9 = 945$ m.u.
Calculation period: $Y_1 = a_1 \cdot b_1 \cdot c_1 \cdot d_1 = 4 \cdot 6 \cdot 8 \cdot 10 = 1920$ m.u.

The total absolute change of the *Y* indicator,
$\Delta = Y_1 - Y_0 = 1920 - 945 = 975$ m.u.

The isolated influence of each factor:
The isolated influence of the factor "*a*",
$\Delta(a: bcd) = (a_1 - a_0) \cdot b_0 \cdot c_0 \cdot d_0 = (4 - 3) \cdot 5 \cdot 7 \cdot 9 = 315$
The isolated influence of the factor "*b*",
$\Delta(b: acd) = (b_1 - b_0) \cdot a_0 \cdot c_0 \cdot d_0 = (6 - 5) \cdot 3 \cdot 7 \cdot 9 = 189$
The isolated influence of the factor "*c*",
$\Delta(c: abd) = (c_1 - c_0) \cdot a_0 \cdot b_0 \cdot d_0 = (8 - 7) \cdot 3 \cdot 5 \cdot 9 = 135$
The isolated influence of the factor "*d*",
$\Delta(d: abc) = (d_1 - d_0) \cdot a_0 \cdot b_0 \cdot c_0 = (10 - 9) \cdot 3 \cdot 5 \cdot 7 = 105$
TOTAL: 315 + 189 + 135 + 105 = 744

Calculation of the proportion of the isolated influence of each factor in the total change of the isolated influences:
Proportion of the factor's isolated influence "*a*" : 315/744 = 0,423387
Proportion of the factor's isolated influence "*b*" : 189/744 = 0,254032
Proportion of the factor's isolated influence "*c*" : 135/744 = 0,181452
Proportion of the factor's isolated influence "*d*" : 105/744 = 0,141129
TOTAL: 0,423387 + 0,254032 + 0,181452 + 0,141129 = 1,000000

- **The influence of the interaction of factors:**
  - Group of 2 factors
  The influence of the interaction of factors "*a*" and "*b*"
  $\Delta(a, b) = (a_1 - a_0) \cdot (b_1 - b_0) \cdot c_0 \cdot d_0 = 1 \cdot 1 \cdot 7 \cdot 9 = 63$
  The influence of the interaction of factors "*a*" and "*c*"
  $\Delta(a, c) = (a_1 - a_0) \cdot (c_1 - c_0) \cdot b_0 \cdot d_0 = 1 \cdot 1 \cdot 5 \cdot 9 = 45$
  The influence of the interaction of factors "*a*" and "*d*"
  $\Delta(a, d) = (a_1 - a_0) \cdot (d_1 - d_0) \cdot b_0 \cdot c_0 = 1 \cdot 1 \cdot 5 \cdot 7 = 35$
  The influence of the interaction of factors "*b*" and "*c*"
  $\Delta(b, c) = (b_1 - b_0) \cdot (c_1 - c_0) \cdot a_0 \cdot d_0 = 1 \cdot 1 \cdot 3 \cdot 9 = 27$
  The influence of the interaction of factors "*b*" and "*d*"
  $\Delta(b, d) = (b_1 - b_0) \cdot (d_1 - d_0) \cdot a_0 \cdot c_0 = 1 \cdot 1 \cdot 3 \cdot 7 = 21$
  The influence of the interaction of factors "*c*" and "*d*"
  $\Delta(c, d) = (c_1 - c_0) \cdot (d_1 - d_0) \cdot a_0 \cdot b_0 = 1 \cdot 1 \cdot 3 \cdot 5 = 15$
  TOTAL: 63 + 45 + 35 + 27 + 21 + 15 = 206

SELECTION OF INTERACTIONS RELATED TO 2 FACTORS:
Factor interactions "*a*" = 63 + 45 + 35 = 143
Factor interactions "*b*" = 63 + 21 + 27 = 111
Factor interactions "*c*" = 45 + 27 + 15 = 87
Factor interactions "*d*" = 21 + 15 + 35 =71
Total = 143 + 111 + 67 + 71 = 412

PROPORTIONS of the interaction in the case of the group of 2 factors:
Proportion of factor interactions "*a*" = 143/412 = 0,3470874

Proportion of factor interactions "*b*" = 111/412 = 0,2694174
Proportion of factor interactions "*c*" = 87/412 = 0,2111651
Proportion of factor interactions "*d*" = 71/412 = 0,1723301

PROPORTIONAL DISTRIBUTION OF THE INTERACTIONS OF 2 FACTORS ON THE INFLUENCE OF EACH FACTOR

For the factor "*a*" = 206 x 0,3470874 = 71,5
For the factor "*b*" = 206 x 0,2694174 = 55,5
For the factor "*c*" = 206 x 0,2111651 = 43,5
For the factor "*d*" = 206 x 0,1723301 = 35,5
Total = 71,5 + 55,5 + 43,5 + 35,5 = 206,0

Group of 3 factors

The influence of the interaction of factors "*a*", "*b*" and "*c*"
$\Delta(a,b,c) = (a_1 - a_0) \cdot (b_1 - b_0) \cdot (c_1 - c_0) \cdot d_0 = 1 \cdot 1 \cdot 1 \cdot 9 = 9$
The influence of the interaction of factors "*a*" , "*b*" and"*d*"
$\Delta(a,b,d) = (a_1 - a_0) \cdot (b_1 - b_0) \cdot (d_1 - d_0) \cdot c_0 = 1 \cdot 1 \cdot 1 \cdot 7 = 7$
The influence of the interaction of factors "*a*" , "*c*" and "*d*"
$\Delta(a,c,d) = (a_1 - a_0) \cdot (c_1 - c_0) \cdot (d_1 - d_0) \cdot b_0 = 1 \cdot 1 \cdot 1 \cdot 5 = 5$
The influence of the interaction of factors "*b*" , "*c*" and "*d*"
$\Delta(b,c,d) = (b_1 - b_0) \cdot (c_1 - c_0) \cdot (d_1 - d_0) \cdot a_0 = 1 \cdot 1 \cdot 1 \cdot 3 = 3$
TOTAL: 9 + 7 + 5 + 3 =24

SELECTION OF INTERACTIONS RELATED TO 3 FACTORS:
Factor interactions: "*a*" = 9 + 7 + 5 = 21
Factor interactions: "*b*" = 9 + 7 + 3 = 19
Factor interactions: "*c*" = 9 + 5 + 3 = 17
Factor interactions: "*d*" = 7 + 5 + 3 =15
Total = 21 + 19 + 17 + 15 = 72

PROPORTIONS of the interaction in the case of the group of 3 factors:
Proportion of factor interactions "*a*" = 21/72 = 0,2916667
Proportion of factor interactions "*b*" = 19/72 = 0,2638889
Proportion of factor interactions "*c*" = 17/72 = 0,2361111
Proportion of factor interactions "*d*" = 16/72 = 0,2083333

PROPORTIONAL DISTRIBUTION OF THE INTERACTIONS OF 3 FACTORS ON THE INFLUENCE OF EACH FACTOR

For the factor "*a*" = 24 x 0,2916667 = 7,0
For the factor "*b*" = 24 x 0,2638889 = 6,3
For the factor "*c*" = 24 x 0,2361111 = 5,7
For the factor "*d*" = 24 x 0,2083333 = 5,0
Total = 7,0 + 6,3 + 5,7 + 5,0 = 24,0

Group of 4 factors

The influence of the interaction of factors "*a*" ,"*b*", "*c*" and "*d*"
$\Delta(a,b,c,d) = (a_1 - a_0) \cdot (b_1 - b_0) \cdot (c_1 - c_0) \cdot (d_1 - d_0) = 1 \cdot 1 \cdot 1 \cdot 1 = 1$

PROPORTIONAL DISTRIBUTION OF THE INTERACTION OF THE 4 FACTORS ON THE INFLUENCE OF EACH FACTOR

For the factor "*a*" = 1 x 0,423387 = 0,423387

For the factor "*b*" = 1 x 0,254032 = 0,254032
For the factor "*c*" = 1 x 0,181452 = 0,181452
For the factor "*d*" = 1 x 0,141129 = 0,141129
Total = 0,423387 **+** 0,254032 **+** 0,181452 **+** 0,141129 **= 1,0**

The relationship to confirm the correctness of the calculations,
$\Delta = \boldsymbol{Y_1 - Y_0}$**= 1920 – 945 = 975 = 744 +206 + 24 + 1**

The explicit influences of each factor that determined the change in the complex indicator Y, calculations:

Influence of the factor *"a",*
$\Delta^{(a)}$ = 315,00000 + 71,50000 + 7,00000 + 0,423387 = 393, 923387 m.u.
Influence of the factor *"b",*
$\Delta^{(b)}$ = 189,00000 + 55,50000 + 6,30000 + 0,254032 = 251,054032 m.u.
Influence of the factor *"c",*
$\Delta^{(c)}$ 135,00000 + 43,50000 + 5,70000 + 0,181452 = 184,381452 m.u..
Influence of the factor *"d",*
$\Delta^{(d)}$ = 105,00000 + 35,50000 + 5,00000 + 0,141129 = 145,641129 m.u.
TOTAL:393, 923387 **+** 251,054032 **+** 184,381452 + 145,641129 **= 975,00000** m.u.

Note. A particular situation for a complex indicator such as "Turnover" can be considered the following functional relationship:

Turnover (Y) = Average number of staff (a) x Degree of technical endowment of work with fixed assets that have an active role in the economic process (b) x Production of the year that returns to 1 leu fixed assets with an active role in the economic process (c) x Degree of capitalization of the production of exercise (d)

It is specified that the value of fixed assets that have an active role in the economic process is included in the model as an average value related to the time period comparable to that to which the turnover refers.

This methodology, exemplified for four influencing factors, is also applicable to complex indicators that are explained by a relationship with 5 or more factors.

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THE SOCIO-ECONOMIC IMPORTANCE OF STEEL - AN OVERVIEW OF GLOBAL STEEL DEMAND

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ABSTRACT: *Steel is one of the most used metals in modern society. Versatility, durability and resistance make it a popular choice for many different applications: metal constructions/confections, pipes for the transport of hot/cold drinking water, parts and parts for machinery, power line poles, auto production, advertising industry, household appliances. Steel is an alloy of iron and carbon containing less than 2% carbon, 1% manganese and insignificant amounts of silicon, phosphorus, sulfur and oxygen. There are more than 3500 grades of steel with different physical and chemical properties. British inventor Henry Bessemer is credited with developing the first mass production technique for steel in the mid-1850s. Steel is still produced using technology based on the Bessemer Process of blowing air through molten iron to oxidize the material and separate impurities. Considering the many fields in which steel is used and the impact of its use on the world economy, in this paper I considered it important to analyze the demand and consumption of steel at the world level. Thus, I focused both on the comparative analysis of world regions and on an analysis of the main ten steel consuming countries worldwide. In my study I used data provided by the World Steel Association, an international organization founded in 1976, which represents and promotes the steel industry globally.*

Keywords*: steel, demand, consumption, world economy*

JEL classification*: L61, N60*

1. INTRODUCTION

Steel is the most important material in the world used in many industrial sectors such as: transport, civil construction, renewable energy and household appliances. A globally competitive economy depends on an efficient, modern and integrated transport network. Almost all vehicles on the road today are made of steel. Railway transport requires steel for trains, rails and infrastructure. Shipbuilding traditionally uses structural steel sheets to manufacture ship hulls. Steel is widely used for aircraft landing gear due to its high strength. The innovative use of very high strength steel in the construction of the machines contributes to excellent performance following the impact tests. And the corrosion-resistant metal coating ensures a longer service life. The housing and construction sector is the largest consumer of steel today, where around 50% of the world's steel production is used. It took 57,000 tons of steel to build the skeleton of the Empire State Building, one of the most recognizable buildings in the world. Also, steel is the main material used in the supply of renewable energy - wind,

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solar and water. In the renewable energy sector, steel products with specific mechanical properties are used in hydroelectric plants for turbines, water gates and valves that take water to the turbines. In the case of wind energy, high-strength steel plates and long profiles are used to make the structure of the towers, and electric steel for generators. Finally, a specific range of flat steel products is used for household appliances, so that the technical performance is optimized. The versatility and resistance of steel make it the perfect material for household appliances. Specific grades of flat steel products are used in a wide range of appliances, including ovens and refrigerators. In addition, for decades the steel industry has been reducing the need to use raw material and encouraging steel recycling. This material is the most recycled on the planet. [3]

The World Steel Association (WSA) is one of the most important organizations in the steel industry, bringing together 180 manufacturers, national and regional associations, and research institutes. Members of the organization produce approximately 85% of the steel delivered worldwide each year. The main purpose of the organization is to promote sustainable development and address the common problems of the steel industry. This includes issues such as climate change, technological innovation, occupational safety and health, international trade and energy efficiency. WSA provides relevant statistics and data on global steel production, consumption and trade. This information is used by the members of the organization, but also by other actors in the industry and economy to understand and determine the evolution and trends in the field of steel. WSA also plays an important role in promoting collaboration between companies to facilitate the exchange of best practices and knowledge in the steel industry. It was founded as the International Iron and Steel Institute on 10 July 1967. In the beginning, there were 18 founding members from seven European countries and from Australia, Canada, Japan and the US. It changed its name to the World Steel Association on 6 October 2008. [4]

2. WORLD STEEL DEMAND

According to the World Steel Association, global steel demand will increase to 1,822.3 million tons, or 2.3%, in 2023, and to 1,854 million tons, or 1.7%, in 2024. WSA representatives pointed out that in 2022, the recovery of the steel market after the pandemic shock was affected by high inflation and rising interest rates, the Russian invasion of Ukraine and the quarantine imposed in China. As a result, activity in steel-using sectors fell in the last quarter of 2022. This, combined with the effect of inventory adjustments, led to a larger-than-expected contraction in steel demand.

Table no. 1. Global steel demand by region, 2022-2024 (million tons)

	2022	**2023 (f)**	**2024 (f)**
European Union (27) + Great Britain	151,8	151,3	159,8
Europe - other countries[1]	39,2	42,1	44,6
Russia and other CIS countries[2] + Ukraine	53,3	51,5	49,3
USA + Mexico + Canada	132,9	135,0	138,1
Central and South America	45,4	46,0	47,0
Africa	40,6	40,5	42,1
Middle East	51,3	52,4	54,1
Asia and Oceania	1267,0	1303,6	1319,1
Total – 63 countries	**1781,5**	**1822,3**	**1854,0**

Notes: [1] Macedonia, Norway, Serbia, Turkey; [2] Belarus, Kazakhstan.

Source: The World Steel Association (April 2023), *Steel Demand Forecast*, https://worldsteel.org/steel-topics/statistics/short-range-outlook/

Persistent inflation and high interest rates in most economies will limit the recovery in steel demand in 2023, despite positive factors such as the reopening of China's economy, Europe's resilience in the face of the energy crisis and the easing of supply chain bottlenecks.

In 2024, global steel demand will increase due to regions outside of China, but at the same time will face a global slowdown due to the forecast stagnation of China's economy. At the same time, sustained inflation will further affect global steel demand. [5]

In the European Union (EU), 2022 ended with a sharper-than-expected decline in steel consumption (-7.2%) as steel demand decreased significantly due to the energy crisis and the impact of the war in Ukraine. It is estimated that the ban on steel imports from Russia will affect products worth 3.3 billion euros. Europe's refusal to buy Russian rolled steel forces Russian factories to redirect the supply to China and Asia. But it is unlikely that this move will provide material economic benefits.

Steel consumption is still forecast to be negative (-1%) in 2023, before recovering in 2024 (+5.4%). Specialists from the European Steel Association are of the opinion that the steel industry has been severely affected at the end of 2022, struggling to recover, but the conditions are not yet favorable. Decarbonization projects are underway, but the EU needs access to green and affordable electricity for a sustainable transition of the steel sector. [2]

The most important steel consumer in the EU is Germany, with a consumption of 31.6 million tons in 2022, which represents more than 20% of the total steel consumption of the EU countries and the UK. (Table no. 2)

Table no. 2. Major consumers of steel worldwide, 2022-2024, (million tons)

	2022	**2023 (f)**	**2024 (f)**
1. China	920.9	939.3	939.3
2. India	114.9	123.3	130.9
3. United States	94.5	95.8	98.2
4. Japan	55.0	57.2	57.9
5. South Korea	51.2	52.7	53.8
6. Russia	41.7	39.6	36.9
7. Turkey	32.5	35.4	37.6
8. Germany	31.6	30.9	34.0
9. Italy	25.1	24.9	25.8
10. Mexico	24.8	25.4	26.1

Source: The World Steel Association (April 2023), *Top 10 Steel Using Countries*, https://worldsteel.org/steel-topics/statistics/short-range-outlook/

China's steel demand contracted in 2021 and 2022 as its economy decelerated sharply due to unexpected nationwide shutdowns caused by the Covid19 pandemic. The construction sector suffered the most in 2021 and 2022. WSA experts believe it will recover moderately in 2023, and China's total steel demand is expected to grow by 2% in 2023 and remain flat in 2024.

As for *India*, the WSA experts opined that after managing inflation well, the economy is set to see healthy growth with an increase in investment in GDP due to strong government spending on infrastructure. At the same time, the residential sector is expected to grow, supported by affordable housing projects as well as increasing urban demand. India's capital goods sector will benefit from the boost from infrastructure and renewable energy investments. Motor vehicles and consumer goods are expected to maintain healthy growth driven by sustained growth in private consumption. After growing by 8.2% in 2022, steel demand in India will grow by 7.3% in 2023 and 6.2% in 2024, WSA estimated.

In the *US*, forecast steel growth in 2023-2024 is expected to be subdued under recessionary pressure, WSA analysis shows. Rising car prices, high gas prices and rising interest rates have caused US car sales to decline in 2022. Analysts expect a recovery of 8.0% in 2023 and another 7.0% in 2024, considering a potential decline in interest rates. However, car sales will reach only 94% of the level recorded in 2019. Infrastructure development is supported by recent legislation such as the Infrastructure Act 2021 and the Inflation Reduction Act (IRA). Demand for steel from the power sector will benefit from expanding power production. However, US steel demand is expected to grow by only 1.3% in 2023 and 2.5% in 2024. [7]

Japan's steel demand contracted in 2022 due to low production levels and reduced inventories. The construction sector will expand in 2023 and 2024 mainly due to civil engineering projects supported by the National Resilience Master Plan. [1] However, labor shortages continue to constrain construction activities. In manufacturing, the industrial machinery and automotive sectors will see growth in 2023 and 2024. Therefore, in Japan, steel demand is forecast to grow by 4.0% in 2023 and 1.2% in 2024.

In 2022, *South Korea* steel demand contracted significantly due to lower plant investment and activity in the construction sector, which was further affected by damage caused by repeated floods in the Pohang region. Although auto production rebounded in 2022 due to easing supply chain constraints and strong exports, moderate growth is expected in 2023 and 2024. However, WSA analysts forecast that car production will remain below pre-pandemic levels, but the shipbuilding sector will contribute to a slight recovery in demand in 2023 and 2024. South Korea will have a steel demand grow by 2, 9% this year and 2% next year.

Russia's economy avoided a full-scale crisis in 2022, and steel demand contracted less than expected. In 2022, it was supported by pipeline projects and residential construction. However, the demand for steel is reduced because 8 of the 14 Russian auto factories have suspended their activities, and the decline of the auto industry could be 50%. In 2023-2024, the construction sector is expected to slow, and Russian steel demand will have an accelerated contraction in 2024. In the next years, the Russian economy will face major challenges due to Western sanctions as well as labor losses caused by the war. Thus, steel demand in Russia is forecast to decrease by a further 5.1% in 2023 and by 6.8% in 2024. [7]

3. CONCLUSIONS

Steel is closely related to the way the world has developed and the way our everyday life has changed. In 1950, in the world, there were only 11 buildings taller than 200 m. Today there are 935 buildings taller than 200 m, worldwide. In the same year (1950), 10 million cars were produced worldwide, their number reaching 80 million today.

Steel is important to the world, being necessary for building a solid future. Affected by crises, the steel market will have to adapt and find new solutions to withstand. Global crises lead not only to a decrease in demand for steel, but also to a decrease in its production. Many of the steel producers are forced to adapt to the market and produce only those materials for which there is demand or lower the price of the others. A surplus of products will be reached, which will mean a drop in prices and maximum competitiveness in the market. Thus, it will be necessary to identify new markets and diversify the products offered, as well as cheaper solutions for steel production. The implementation of technologies that lower production costs and increase the quality of the resulting products is one of the solutions to overcome the crisis. The evolution of the steel market for 2023 remains subject to a high level of uncertainty, which will probably continue to undermine demand in the sectors that use steel. Given the current

context, against the background of a worsening energy crisis and the shortage of raw materials, we cannot exclude a new recession or a stagflation scenario.

The outlook for 2023 remains negative, paving the way for the fourth downturn in steel demand in the last five years. A modest recovery is emerging in 2024, albeit subject to high uncertainty caused by energy price developments, Russia's war in Ukraine and their impact on inflation and global supply chains.

Steel manufacturing is expected to lead the recovery, but high interest rates will continue to weigh on steel demand. Recycled-content steel could benefit from another trend identified by the group. Investments in decarbonization and dynamic emerging economies will increasingly drive positive momentum for global steel demand, even as China’s contribution to global growth diminishes.

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NEW REQUIREMENTS IN INTERCULTURAL COMMUNICATION IN ECONOMIC AFFAIRS

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ABSTRACT: *A key role in the development of economic affairs is the extension of intercultural communication skills. Intercultural communication favors a better understanding between heterogenous groups of subjects involved, on the one side, and the quality of economic activities, on the other side. The aims of this research are to highlight the place and the role of cultural features within the framework of the new paradigm of the era of globalization - integrated communication, and to define the requirements imposed by the digital revolution in creating and using the IA (Artificial Intelligence) databases in modern languages in relation to business negotiations.*

The results of the research maintain that the formation of the EU integrated economic market does not lead to alteration or disappearance of the cultural features of business partners. On the contrary, the economic actors making efforts to know, respect and use cultural features of the future business partners enhance their competitiveness and may conquer new segments of their organization market and access new markets.

Keywords: *interculturality, plurilingualism, artificial intelligence, linguistic technology platforms.*

JEL Classification: O33, Z13.

1. INTRODUCTION

Over the past years, development of digital technologies as well as intense extension of both mass-media and informational and cultural systems have led to a new social communication map. All these changes have rendered the gap between regions, groups, individuals and cultures more widely accepted and quicker. At present, the business environment needs experts in intercultural communication able to understand and interpret the potential causes of the misunderstandings between partners, on the one side, and ensure accurate transfer of knowledge, on the other side.

This paper shows the results of a lengthy theoretical research aiming at the interference between intercultural communication and business communication in relation to globally spread dialogue. The new interactionist communicational paradigm, which also functions in the field of business communication, integrates the facilities of the IA technologies so that a new cultural convergence emerges, a convergence enabling all parties involved in negotiation to identify similar interests and efficient ways to meet the requirements of the consumers on the target markets.

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The IA technologies allow complex economic analyses conducted while negotiating. Such analyses support understanding the customers' buying and consumption particularities, fairly and completely presented in all cultures, in all written and spoken languages present on the market which has turned into a market without frontiers. Nevertheless, a market which has segments, areas, regions of cultural specificity. Virtues integrating intercultural communication into the new paradigm of complex communication relying on IA are therefore analyzed, the viewpoint being that one should avoid a mechanistic alienation of the communication mix in the sector of business environment. The issues relating to identification and treatment of objections inherent in communication should not be settled using equally proportional arguments. We support the supreme value of interhuman business contacts integrating everything that the science provides towards accurate and updated data. Nonetheless, we count on preservation of conviviality, expression and valorization of emotional communication between present and future business partners.

The paper is theoretical and comes along other scientific initiatives which support the primordial role of communication abilities. This is different from communicational competence, yet they both form a functional whole conferring efficiency in conducting business negotiations and conclusion of some contracts so as to ensure satisfying market demands and, following this successful process, enhancing the capacity of the Romanian specialists acting in economic affairs to communicate in an interpersonal manner.

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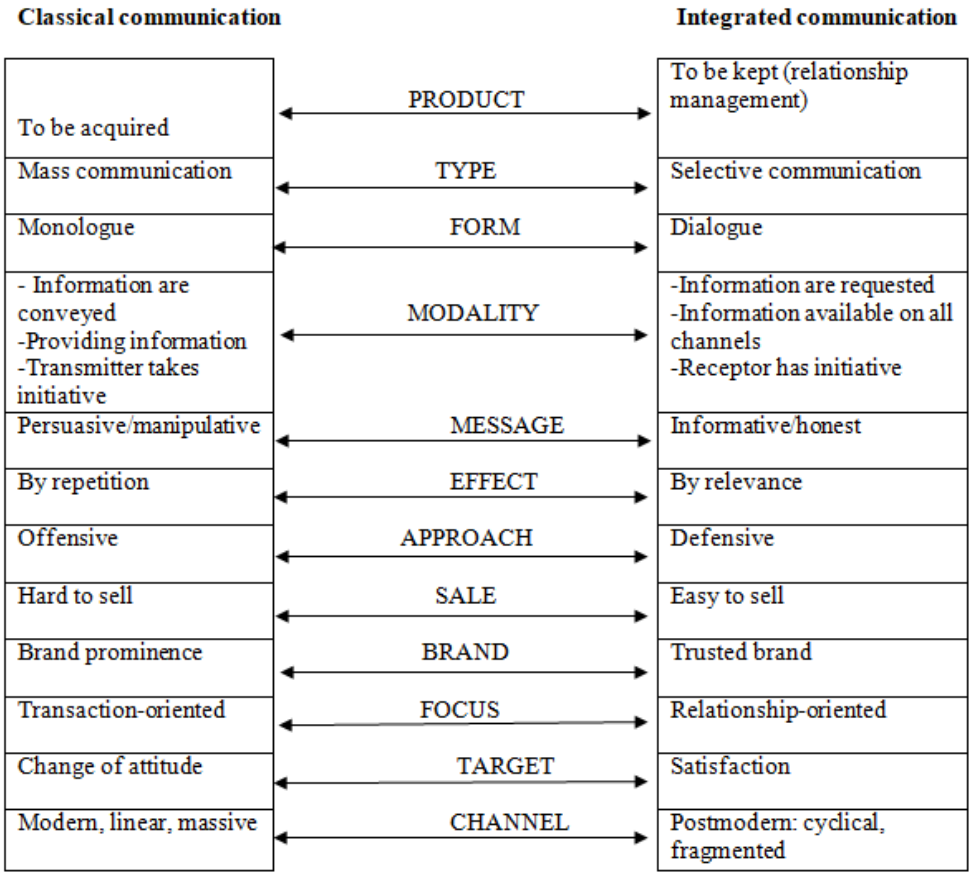
2. LITERATURE REVIEW: CULTURE, A VARIABLE FOR SUCCESS IN INTERNATIONAL BUSINESS

Culture, business and communication are in a relation of synergy (Sasu, 2009). One cannot speak of negotiation or doing business and disregard culture (unlike corporate culture), formation and training negotiators. Intercultural business practices are permanently updated, similarly to integrated intercultural communication models. It is difficult yet necessary to understand the behavior of negotiation partners and to establish a strategy allowing all parties to work in harmony in a business context. Cultural profiles of Americans, Chinese, Saudis, Mexicans, etc. have been outlined and some general tendencies such as distancing oneself from power and group orientation have been mentioned. However, negotiators belonging to a certain group have a different behavior from the ones who are part of other groups even though they share the same culture. Americans, for instance, have different formality levels, mimicry, body language, tonality, and language depending on whom they negotiate: employees of their own company, negotiators from other American companies or negotiators in foreign companies.

Negotiators in a multinational company are each bearers of the culture in their home country. Nevertheless, in the process of a business meeting, they fall under the cultural traits of their corporation despite using the same ethnic language. They actually form a new culture, a new model and not an amount of cultural behaviors (Sasu, 2009). The employees in charge of negotiation and conclusion of economic contracts permanently study cultural communication in business and use interaction with their peers in other cultures, facilitated by Artificial Intelligence which saves time allocated to internet use and removes connection problems. What we witness is a pluralisation of values inside modern societies (Tantau, 2002) as well as a dynamization of such values. Furthermore, we see a differentiation of economic behavior, innovations, new organization and management technologies and a tremendous wave of changes in the field of communication and business promotion. Contemporary requirements impose that negotiators should have intercultural communication expertise and be prepared to practice environmental responsibility and social justice. Corporate culture, their knowledge and communication abilities are components of an intangible asset – reputation, i.e. stakeholders' perception of the organization, perception which is measurable in value (for example, using the

NPS - Net Promoter Score Method). A good reputation is a source of competitive advantage (Doorlay et al., 2017). Integrated communication has significant difference compared to classical communication (Figure 1).

Figure 1. Major differences between classical communication and integrated communication



Source: Adaptation by Yamada, H., 2017, cited in Florea, N.V., Tanasescu A.D. [4:53]

The dynamics and the complexity of the external factors influencing the activity of the organizations have imposed a fundamental review of the communication process. The consumer is assaulted by a huge volume of information which they are unable to process in an efficient manner so most of the information was screened and removed. Increase of the importance of brand, internationalization of business, unprecedented atomization of the demand as well as the evolution and spread of new technologies have been key factors leading to development of integrated communication.

This management concept requires that all aspects of communication – publicity, promotions, public relations, brand image, should cooperate in a single voice towards conveying a unitary coherent message coordinated on various channels aiming at the customer whose behavior should be influenced in the decision-making process and turn them into loyal customers as quickly as possible. The loyal customer is loyal to the brand while the trust they gain facilitates their orientation so that the time allocated to purchase-related decision is significantly reduced.

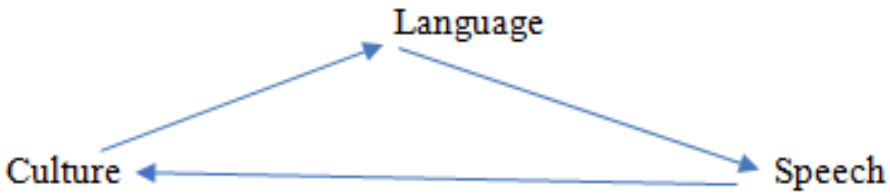
Integrated communication is cyclical in the sense that the bidders create systems intended to collect consumers' feedback in order to permanently improve the quality of the products and services, ensure a quality-price ratio in line with the level and the structure of the

demand, and diversify distribution channels according to the customers' requirements and the context on the market.

2. LANGUAGE – CULTURE BINOM

The French linguist Emile Benveniste makes a distinction between language and speech taking the logical roadmap from linguistics to language (Lesenciuc, 2017). As early as 1966, Benveniste defines language as "a system of structures simultaneosuly belonging to community and collective". The determining connection between them is achieved through language which for the transmitter expresses a reality and for the receptor a recreation of such reality in a proper, particular decoding manner" Speech coagulates culture" (Lesenciuc,1966) (Figure 2) .

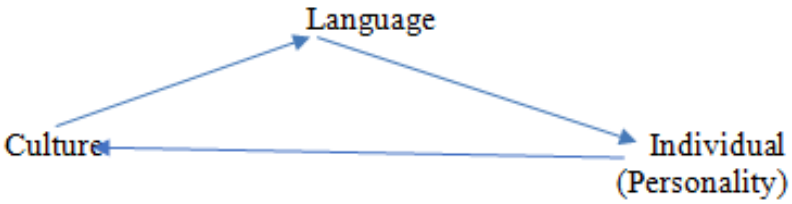
Figure 2. Culture-language-speech interdetermination



Source:Lesenciuc, A. ,2017, p.135.

Language is a a revealing element of society "Speech is individual and represents a geometrical place of interaction between individual and society, between thinking and culture" (Figure 3).

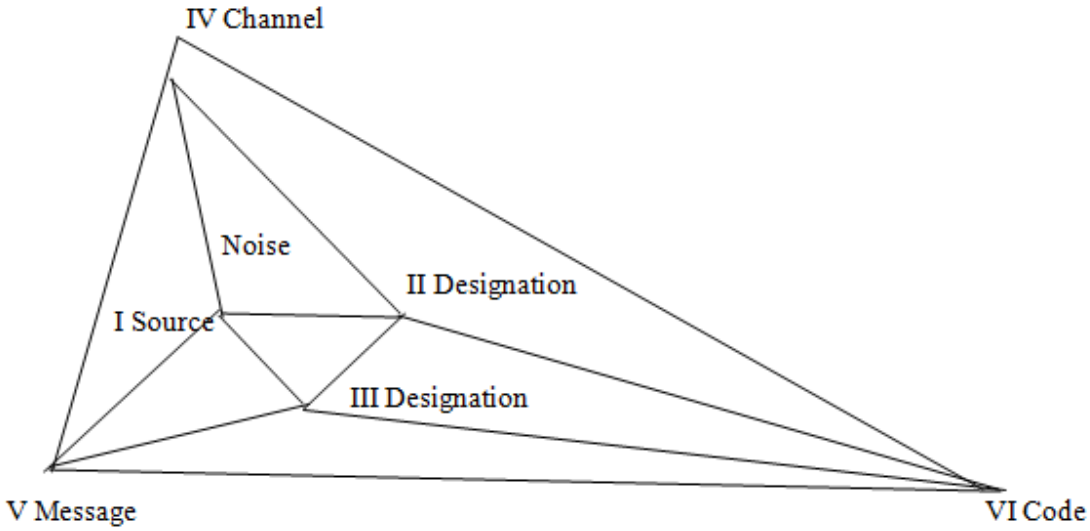
Figure 3. Culture-language-individual interdetermination



Source: Lesenciuc, A., 2017, p.136

The American linguist of Hungarian origin Sebeok studies and validates the functions of language as conceptualized by his predecessors Buhler and Jacobson, and starting from Shannon's model, he proposes a semiotic more detailed triangle (Figure 4) which highligts the complex structure of communication (Trandabat, 2002).

Figure 4. Sebeok's semiotic diagram

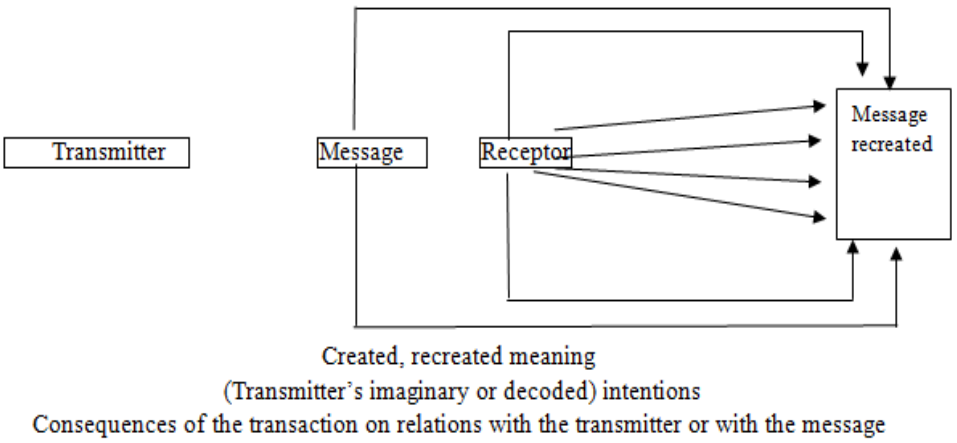


Source: Lesenciuc, A., 2017, p.142.

The models presented, as many others that came in succession, are mechanistic models which grant the primordial role to the transmitter, the one who builds and launches the message.

In 2002, the American researcher Lee O. Thaer lays emphasis on the role of the receptor and, in a transactional manner, he elaborates a model revealing orientation towards destination and incorporation in the message of both primary data (content of the message) and contextual communication elements (Figure 5).

Figure 5. Thaye's Model



Source: Lesenciuc, A., 2017, p.155.

In Thayer's model, the receptor stands in the forefront. He practically creates the message, assigns meaning to it and turns communication into a relation. Thayer's model suggests that decoding messages and formation/influencing receptors' opinions depend on the cultural baggage of each individual, their own scale of values.

3. ARTICIFIAL INTELLIGENCE – COMPONENT OF COMMUNICATION AND COLLABORATION IN ECONOMIC AFFAIRS

For complex and unified communications within business negotiations and to increase the reaction speed as well as the management of operation flows in conducting business, employees can use several AI technologies such as: i) programmed learning; ii) natural language processing (NLP); iii) robots or software applications for repetitive, simple activities; iv) speaking, text dictation, text conveyed into speaking; and v) robotics (Blair, 2019). AI may be defined as an ensemble of technological components collecting, processing and acting on data in ways which simulate artificial intelligence. Similar to humans, AI solutions may apply rules, may learn in time through acquisition of new data and information and may adapt to changes in their environment (Russel and Norvig, 2006). Artificial intelligence is perceived as a sector of the computer science which uses intelligent human-like thinking and acting machines. This includes recognition of speech, natural language processing, image recognition etc. (Bucea-Manea et al., 2022).

IA instruments carry out all and any time-consuming operation and provides highly accurate information in pre- and post- business negotiating periods as well as during business negotiations. Moreover, as the volume of the information becomes heavier, the AI instruments pinpoint other actors of B2B and B2C markets of which activities are correlated to those of the economic agents involved in negotiations, consolidating therefore the quality of the relations.

Marcin Franckiewicz (2023) has recently posted an article regarding the potential of GBT-4 natural language processing (Generative Pre-trained Transformer 4). This NLP generates a response to any request of information concerning workplaces, formation of digital abilities, entrepreneurship. GBT-4 practically reduces the digital gap and enables people to contain modern technology use skills. GBT-4 processes language, including for persons with various disabilities. GBT-4 may connect people from different communities and is able to create language models in various languages even though the participants do not know the language and come from completely different cultures. The linguistic gap between cultures is effectively reduced by GBT-4 which processes natural language and generates linguistically and semantically accurate texts, translations between languages, contextual conversations.

Effective April 2021, the European Commission proposed the first normative EU regulation on AI with a view to analyzing and classifying applications according to risk levels for consumers, with the observation that AI systems will be supervised by people and not through automated processes as there are different rules depending on the risk levels. This regulation is the first regulation of such kind around the world and follows extensive research (Eurobarometru, 2017.UE-28). The research revealed that 61% of the Europeans have a favorable opinion of AI and robots. On the contrary, 88% state that AI technologies have to benefit from a high-performance thoroughly-applied management.

The law sets the following risk AI systems: high risk, with two sub-systems components; generative AI, such as ChatGPT, and limited risk.

All risk categories are widely detailed, debated and negotiated with the final stated objective that the final form of the law should be adopted in the European Parliament by the end of 2023.

4. ARTIFICIAL INTELLIGENCE AND ITS USE IN ROMANIA IN BUSINESS AND EVERYDAY LIFE

Along with the evolution of digital technologies, there is an increasingly spread practice to use artificial intelligence in everyday life. Whether we speak of a Google research, or an e-order, an online payment or simply watching TV news, AI is capable of completing all these

activities. AI is present in our daily life through virtual assistants. AI supports not only us, human beings as physical persons, but it also represents a real benefit for companies. The organizations implementing such digital technologies can increase sales of their products and provide their customers with better services both leading to better indicators. In addition, AI ensures better operation of companies and generates lower costs (Loureire et al, 2021). Artificial intelligence transforms businesses, economy and society and consequently experiences and relations between the parties concerned and citizens. Throughout time, there have been many specialists who have shown a genuine interest in using AI in business and in getting to know their role. Therefore, Huang and Rust (2018) have studied the AI impact on the employees' tasks (Huang and Rust, 2018) while Flavian and Casalo have highlighted the benefits of AI use in the sector of services (Flavián and Casaló, 2021). AI is successfully used in several economic areas. In marketing, it is successful in automation of repetitive functions and marketing activities, in processing data to help the decision-making process, on the one side, and the strategic planning, on the other side (Huang and Rust, 2021). AI has the capacity to adapt to any environment and it is at present a source of innovation, in particular in the sector of services. Rapid development of technology and the AI impact on society represent a challenge for the decision-making factors. The necessity to regulate the artificial intelligence systems is widely recognized (Smuha, 2021).

Digital technologies have been used more and more frequently both worldwide and nationwide. Therefore, the Research Institute for Artificial Intelligence within the Romanian Academy (RACAI) has created language models starting from some large size corpora. The systems and the resources for language technology applications are beyond comparison when it comes to the degree of coverage and the quality of the ones already in place for English language. There are also discontinuities in financing research and development.

On May 16 2020, in Marseile, there was the first international workshop on linguistic technological platforms. The key subject was the European Linguistic Grid, a platform with thousands of sets of data and hundreds of linguistic technology services for all European languages and cultures, adapted to their social and economic needs. The grid is financed through the Research and Innovation Program of the European Union, ORIZONT 2020.

The Artificial Intelligence (AI) is of strategic importance for the economic development. In our country, only 6% of the companies use AI applications. We come last in Europe in relation to use of AI by Romanian-owned companies, despite the fact that, paradoxically, the Romanian economy takes the 19th place in a classification of complex and sophisticated economies worldwide. The Economic Complexity Index (ECI) of Harvard Kennedy School of Government, the number and the complexity of the products exported place our country some places below China (17), France (18) and above Poland (26), Bulgaria (39) (Toma, A., 2023).

5. CONCLUSIONS

Business globalization does not mean extinction of cultural particularities of producers, traders and consumers of goods and services. It only means knowing them best possible so as to create an intercultural offer which should satisfy the needs of a large group of customers. The changes in the structure and the volume of the demand of goods and services occur extremely rapidly against the background of a more and more intense people and business mobility and reduction in cross-border barriers.

Business negotiations rely on creation of some sound databases and direct contacts or contacts mediated by representatives of companies acting as bidders or beneficiaries. Linguistic technology platforms enable storage of databases and conduct of operations of negotiation and contracting in any language agreed upon by partners, in addition to English language (lingua

franca), which means an emotional communication harmonized with a proper atmosphere enhancing the quality of the negotiations. The new technologies slow down the already consistent process of extinction of some languages in the process of business communication with negative effects since there is a loss of cultural advantages incorporated in the vocabulary of each language in the economic area concerned by the business.

All economic actors mainly use English language which has become Lingua Franca. Nevertheless, the spectacular evolution of artificial intelligence (AI) leads to an already visible evolution towards high-performance databases in almost all business languages which have become competitive advantages. The consumers impose respect for their buying and consumption customs and traditions, whereas the bidders highlight the capacity of goods and services to create and satisfy emotions.

The field of intercultural communication in connection with study and creative application of AI technology become captivating not only for the specialists in production and sale of goods and services, but also for the general public from among who companies identify future customers and fight to gain them. Romania has demonstrated that it may be an active player on the European and global economic market, by assimilating new digital technologies and by practicing in economic affairs the respect for the partners' culture and the responsible management of cultural differences in the process of negotiation, conclusion and performance of economic contracts.

Finally, we express our conviction that the technological and scientific advance will generate improvement of all economic and cultural processes which contribute to the physical and mental wellbeing of the greatest being in the Univers – the human being.

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THE ROLE OF DIGITALIZATION IN THE TRANSITION TOWARD CIRCULAR ECONOMY

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ABSTRACT: *The paper presents the ways in which the digitalization can contribute to an effective transition to a circular economy. Digitization can enable the intelligent use of limited resources, both on a human and material level. Therefore, we can say that digital society can influence the transition process and ensure the acceleration of the transition to a, circular economy.*

Keywords: *digitalization, digital economy, circular economy*

JEL Classification*: O33, Q56.*

1. INTRODUCTION

In recent years, the urgent need for digitization has been intensively discussed. In full era of the modern technologies', which penetrated more and more into almost all aspects of private, economic as well as political life, appeared the need to adapt to the new coordinates imposed by them. The modern technologies not only take over from people tasks that once were done manually and repetitively, but it can create completely automatic processes, which do not need the intervention of people.

Digitization can enable the intelligent use of limited resources, both on a human and material level. This could reduce the need for physical equipment, thus reducing the consumption of materials, energy and fuel. Last but not least, digital technology allows the use of generic computing and user interface hardware, which means a reduced need to produce dedicated devices [1]. Modern technologies can be used to improve services, to produce safer equipment and machines and, at the same time, it can improve production processes and bring competitive advantages to businesses, including in sectors that already enjoy significant positions, such as the circular economy, the car manufacturing industry, agriculture and tourism [2].

Digital transformation has the ability to influence the transformation of the economy from a linear to a circular economy. On the one hand, digital society has all the necessary technical means to ensure circular processes, and on the other hand, it creates a perspective of long-term sustainable development, which is significant for the development of a circular economy [3].

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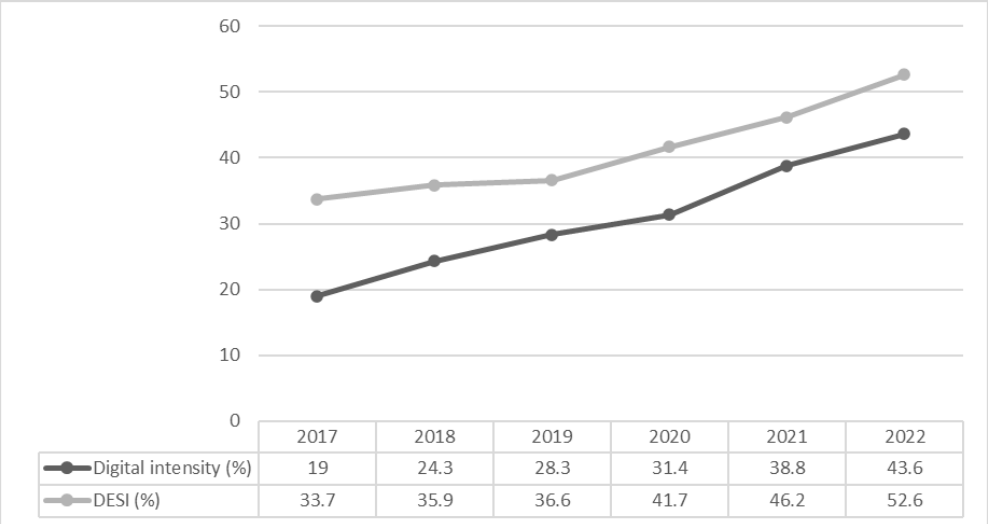
2. DIGITALIZATION AND TRANSITION TOWARD TO CIRCULAR ECONOMY

Digitization involves using the possibilities offered by new technologies to rethink all aspects of operational processes. Some studies estimate that the digitization of products and services will generate for European businesses annual revenues of over 110 billion euros [4]. For many EU businesses, openness to digital transformation is essential if they want to remain competitive. According to a European Investment Bank study, digitization is associated with better business performance in terms of productivity, management practices, innovation, growth and well-paid jobs [5].

Digital transformation is one of the EU's priorities and consequently it seeks to develop policies that will strengthen Europe's capabilities in the new digital technologies, open new opportunities for businesses and consumers, support the green transition and help achieve climate neutrality by 2050.

Figure 1. The evolution of digitalization level in EU, 2017-2022



	2017	2018	2019	2020	2021	2022
Digital intensity (%)	19	24.3	28.3	31.4	38.8	43.6
DESI (%)	33.7	35.9	36.6	41.7	46.2	52.6

Source: author own processing based on Eurostat data

The long-term vision of the European Union on its competitiveness and the perspectives of the economy after 2030, published in March this year, highlights the fact that digitization is one of the main vectors of the economy [6]. As a consequence of the implementation of appropriate policies for stimulating digitalization, as it can be seen in Figure 1, the level of digitization at European Union level has increased from year to year, the digital intensity increasing with 129,47% from 2017 to 2022.

On the background of increasingly limited access to natural resources and the challenges generated by the effects of climate change, the theme of a more environmentally friendly and sustainable economy is increasingly present in the public policy makers and economic agent’s discourse. Associated with sustainable development, the concept of the circular economy is increasingly seen as a lever for sustainable progress.

The circular economy involves a number of concepts such as sharing, renting, reusing, repairing, refurbishing and recycling materials and products. This approach has the effect of extending the life cycle of products and optimizing the consumption of raw materials and energy, minimizing the amount of waste generated, reducing the carbon footprint and more environmentally friendly approach.

In the case of the circular economy, we are talking about an integrative model, based on eco-innovation and eco-design, characterized by the 10 R concept: Refuse, Rethink, Reduce, Reuse, Repair, Restore, Remanufacture, Reorient, Recycle and Recover.

Refusal refers to making a product redundant by giving up at the function it provides (for example the option to refuse to use your own car for urban transportation, opting for public transport or a ride-sharing service.

Rethinking refers to increasing the use of a product, for example by sharing the product (for example in food industry, in order to reduce the amount of waste, it is used the collaborative approach to reduce the use of single-use packaging and the migration to reusable packaging).

Reduction refers to increasing efficiency in the production or use of the product by consuming fewer natural resources (for example, in the automotive industry where the pressure to reduce fuel consumption has intensified innovation and the successful launch of electric models).

Reuse refers to any operation by which products or components that have not become waste are used again for the same purpose for which they were designed.

Repair refers to the reconditioning or maintenance of the defective product so that it can be used with its original function.

Refurbishing refers to restoring an old product and updating it.

Remanufacturing refers to incorporating parts of the discarded product into another product with the same function. Old laptops and computers are reclaimed for parts to create refurbished products that can then be donated to schools.

Reorientation refers to the incorporation of the discarded product or parts of it into a new product with a different function. For example, paper, plastic, metal, wood and other materials left over from manufacturing processes can be reused to make various other items.

Recycling refers to any recovery operation whereby waste is transformed into products, materials or substances to fulfill their original function or for other purposes.

Recovery refers to the incineration of materials and energy recovery. We meet the model in the cement industry, where waste incineration is used in the manufacturing process or in the burning of non-recyclable materials to obtain energy [7].

In line with the Union's objective of achieving climate neutrality by 2050 under the Green Deal [8], the European Commission proposed, in March 2020, the first package of measures for the transition to a circular economy, included in the Circular Economy Action Plan [9]. Proposals include encouraging sustainable products, informing consumers for the green transition, revising building materials regulations and a strategy for sustainable textiles [10].

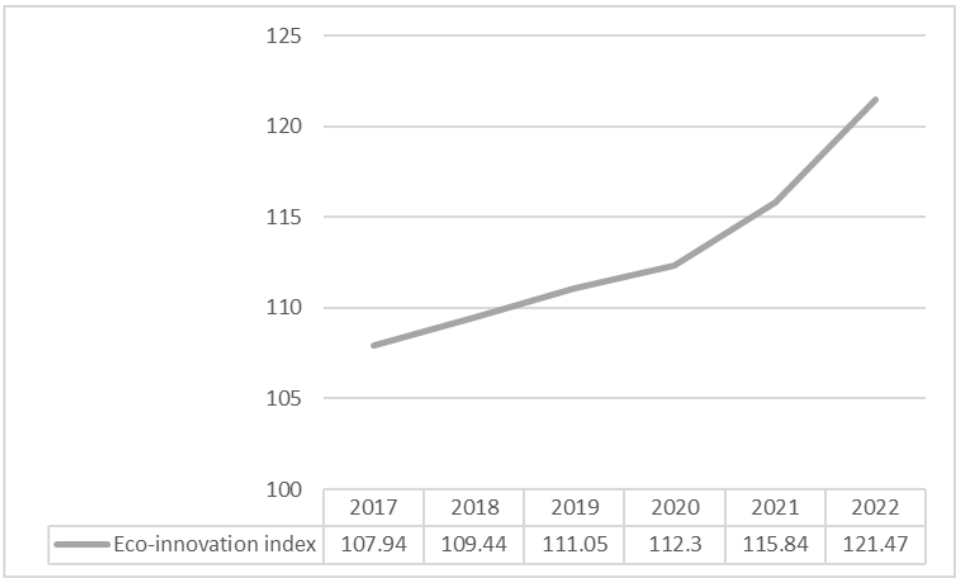
To achieve a circular economy, circularity and sustainability must be introduced at all stages of the value chain, from design to production and finally to the consumer. Circularity encourages innovation and job creation, and some experts believe that, by 2030, this model could generate an additional income of 4.5 trillion dollars globally [11].

The European Commission estimates that applying circular economy principles across the EU economy has the potential to increase EU GDP by an additional 0.5% by 2030, creating approximately 700,000 new jobs. There is a clear business case for individual companies too – since manufacturing firms in the EU spend on average approximately 40% of the total cost of goods on materials, closed-loop circular models can increase profitability and protect against price fluctuations [12].

In supporting the transition to a circular economy and achieving the objectives of the European Green Deal eco-innovation is vital, by reducing impacts on the environment, increasing resilience against external pressures and using resources more efficiently. [13]. The Eco-Innovation Scoreboard gathers data on eco-innovation performance across the EU and

beyond, thus helping to monitor and evaluate progress made since 2010. The Eco-Innovation Index measures the environmental innovation performance of EU Member States, on the basis of the 12 indicators included in the measurement framework. In the period 2017-2022, the Eco-innovation index at the EU level increased constantly, reaching in 2022 the value of 121.47 (+ 12.31% compared to 2017) as a result of the policies applied in the field of environment, research-innovation and digitalization.

Figure 2. The evolution of Eco-innovation index in EU, 2017-2022



Source: author own processing based on Eurostat data

Digital technologies play a key role, both directly and indirectly. On the one hand, they make it possible to create and manage the information required for complex circular supply chains and business models. On the other hand, they are the basis for products-as-a-service business models, a crucial part of the dematerialization process. Overall, digitally enabled transparency, efficiency and convenience are necessary to increase resource productivity and value retention to the point where a circular economy really begins [14].

With more data generated than ever before, improved exchange and provision of information is a cornerstone of the circular economy: now, companies must know the suppliers of their suppliers and the customers of their customers (ECERA, 2020). Precise and timely data are necessary for the safe processing of concentrated waste streams, safe sharing and recycling of products, increasing product longevity or improving material efficiency/replacing rare inputs with renewables. Shortened supply chains and localized/decentralized production also depend on digitalization. Improving connectivity and information sharing, offers significant benefits, by using blockchain to securely trace products and materials across their entire lifecycle and in all use environments [14].

Without a coherent and inclusive global digitization effort, climate goals will not be achieved in a timely manner. Furthermore, in order to achieve the 2050 climate goals, a coherent digital network must be created. This will have the same impact on the circular economy in the next 30 years as the Internet has had on the digitization of society in the last 30 years. Without a digital platform, the transition to a circular economy will occur more slowly, with fewer attractive circular business models and less impact on global climate goals, economic growth and poverty reduction [12].

3. CONCLUSIONS

Digital technologies will play a key role in Europe's transition to a more circular economy. Without them, a modern economy cannot become truly sustainable.

The digitization of the circular economy cannot be postponed; We don't need more conferences, reports and calculations. Our planet and the many people suffering from climate change compel us to act now. Governments, global organizations, industry associations and leading enterprises must take the initiative to ensure the focused, accelerated and responsible digitization of the circular economy. This is the only way we can achieve our ambitious climate goals and save our planet.

Through the transition of European states to the circular economy, the pressure on natural resources will be reduced and sustainable economic growth and new jobs will be ensured. Moreover, it will contribute decisively to reaching the 2050 targets on climate neutrality and biodiversity loss.

To a large extent, any successful transition to a CE will depend on the contributions and collaboration of consumers and citizens, on the way people live and consume materials and products. The better people are informed, the more they are aware of the impact their choices have, and the more rapid this process will be. Moreover, encouraging people to collect data and providing them with tools to make their wishes and concerns heard can improve monitoring of product lifecycles and other variables [14].

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