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Complementariness and "Attraction" in Modelling

> *"Opposites agree and resulting from the discordant things is the finest harmony; (everything is born out of struggle)".* Heraclitus (The Greek philosophy until Plato, vol. 2 part 2, p. 351, Editura ştiinţifică şi enciclopedică, 1984).

The following premises are at the basis of the problems tackled in this study:

a) the existence of a relation of complementariness noticeable both in nature (processes of symbiosis, male-female couple) and in social life (the demand-offer relation, the man-tool relation);

b) the manifestation of an attraction/search process which, either it is immanent, as it can be noticed with living beings, or it is learnt/ordered, in case of social activities or bodies. Seeking, the selection taking place in the living cell system in view of attracting from the surrounding world of those potentials which updated maintain the life of the biological system[1] represent an illustration of the attraction/seeking process.

The aim of cooperation among the complementary elements is most often to maintain a certain state, eventually to ensure its evolution towards a higher level.

Transposing the problem of complementariness-attraction in the field of representations we consider that this aspect is implied though not in a declared way in case of the description of the structure of systems pursuing the control of social processes.

Restricting the problems to the modelling aspects, we consider, in the following, a third premise:

c) most of the methods, models and algorithms regard relatively restricted aspects which makes necessary their assembling whenever complex problems of social life are approached. We consider useful mainly for the

[1] STEPHANE LUPASCO: *The Dynamic Logic of the Contradictory.* Editura Politică, Bucharest, 1982.

field of creating artificial intelligence the aspects directy or indirectly linked with what we call complementariness and attraction.

The following principles are considered proper with a view to achieving "the assemblage" of complementary elements;

— objectivation implying that both the estimation of the extent to which an element is complementary with another and the starting of the seeking process should be subordinate to the objective pursued;

— compatibility, in the sense that the concatenation of some complementary elements implies a real or potential transmission of information on activities, assets, results, etc. Transmission implies flows of intelligible messages so that what an output represents for an element can be received as a message of input for the associated element;

— restraint as regards both the characteristics in keeping with which we estimate complementariness and the computation relations with a view to measuring it or facilitating the seeking processes;

As to the elements involved in a seeking process in view of the assemblage, they can be: systems, activities, processes (for example, complementary economies, the foreign trade activity carried out by two countries, the process of blending planning with initiative in various activities, etc.) or methods, models, algorithms for example linear regression and linear programming combined in optimizing a process influenced by a measurable factors). In the first case, stress is laid on the stage of measuring the grade of complementariness among systems, activities, etc.; in the second case, of particular interest is "attraction" (the seeking process).

As regards the relations among elements, we distinguish a typology of forms:

A. the attraction complementariness (positive) in the sense of mutual completion with a view to obtaining higher performances (cooperation among specialists in various fields but who complete each other; the demand-offer process) which, in its turn may be:

A.1. achieved through an intermediary (industry and agriculture imlpy the existence of trade);

A.2. achieved according to the "interests" of one of the elements (foreign trade between two countries regarded from the point of view of the economic interests of one of the countries);

B. complementariness of rejection (negative)[1] or indifference in the sense of the existence of certain characteristics that hinder or at the best do not justify cooperation among elements (for example two factories producing the same products and interested in preserving their structures; two methods conducive to the same results).

As regards the measuring of the grade of complementariness, it is conditioned by the possibility for a digital estimation in a unitary way of the characteristics considered essential in relation to the objective pursued.

[1] The existence of assets with an antagonistic effect is accepted by N. Georgescu Roegen in "The Law of Entropy and the Economic Process", Editura politică, Bucharest, 1979 and, consequently he considers that what he called the principle of complementariness is not always valid.

For a complementariness of attraction of type A, in the hypothesis of estimations of the levels of characteristics in the form of shares, we consider proper the utilization of the coefficient defined by the ratio:

$$C_{xy} = \frac{\sum_{i=1}^{m} p_i q_i}{\sum_{i=1}^{m} p_i^2 \sum_{i=1}^{n} q_i^2} \tag{1}$$

where: p_i — the share of characteristic i for the element X
q_i — the share of characteristic i for the element Y

$$\sum p_i - \sum q_i = 1$$

The calculus relation (1) is based on the coefficient of the information correlation[1] defined by O. Onicescu. The approach of the level of the coefficient to the maximum level 1 shows the analogy, the ever greater resemblance between the level of the characteristics belonging to the two elements M and X; the difference between the value of the coefficient and 1 expresses the grade of disassociation, of dissimilarity and, consequently, the potential of mutual complementarity of the two elements.

As regards the A2 type complementariness it can be measured by using the coefficient defined as follows:

$$C_{X-Y} = \frac{1}{2}\left(\sum_j \frac{\bar{y}_{jR}}{x_{jR}} \cdot \frac{x_{jk}}{X_R} + \sum_j \frac{x_{jK}}{y_{jR}} \cdot \frac{y_{jR}}{Y_R}\right) = \frac{1}{2}\left(\frac{\sum_j \bar{y}_{jK}}{X_R} \frac{\sum_j \bar{x}_{iK}}{Y_R}\right) \tag{2}$$

where: x_j, y_j — characteristics which complete each other (for example the country's export $R - x_{jR}$; the country's import $K - y_{jK}$ for the merchandize j);

$\bar{y}_{jK}$ — the level of characteristic j, if $y_{jK} > x_{jR}$ it becomes equal to x_{jR};

$\bar{x}_{jk}$ — level of characteristic j which, if $x_{jK} > y_{jR}$ it becomes equal to y_{jR};

$$X_R = \sum_j x_{jR}; \quad Y_R = \sum_j y_{jR}$$

The measuring of the grade of type A1 complementariness makes it necessary to eliminate the intermediate link and to apply, according to circumstances, relation (1) or (2). In case that rejection characteristics (case B) exist and they should be taken into consideration, the inclusion into the calculus of their value with the sign minus in the additive type relations (1), (2) would represent a way for a solution.

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[1] For details on the concept of informational energy and information correlation, we recommend: Onicescu O., Ştefănescu V.: *Elemente de statistică informaţională şi aplicaţii*, Edit. tehnică, Bucharest, 1976.

The problem of finding those elements which by associating their properties should lead, according to the objective proposed, to higher performances, may be approached from the point of view of the seeking methods.[1] Thus, in case of the type A and A2 complementariness, the dimension of the coefficient defined through relations (1) and (2) may serve as basic index in estimating the opportuness of assembling two elements. The backtracting technique known in the literature on artificial intelligence can be applied with good results. We have shown that for type A1 and B complementariness, relations (1) and (2) can also be useful and consequently the same seeking technique may be used.

In situations when we aim to assemble methods presenting a certain grade of complementariness in relation to the objective pursue, the problem is posed somewhat differently. In most frequent cases, the obtaining of chains of methods is pursued. For example, to know some latent causes decisive for a phenomenon the following succession of statistical methods may be taken into account: the organization of data in the form of statistical series — the dispersional analysis-statistical correlation-multiple factorial analysis. In such situations, one can admit at most a type A2 complementarity. Reciprocity in such cases would be present only in the sense that a method supplies the data or confirmations necessary for another method which, in its turn, turns to best account the results of the first method. The assemblage of complementary methods in the real sense of the term is not, however, excluded.

The process of finding methods conducive to higher performances through assemblage can be facilitated by achieving an adequate coding. The catalogue of the methods introduced into S.S.P will have to take this aspect into consideration. The results obtained through a model or method will have to be coded accordingly so that in point of the content and of the measure unit, they should be intelligible and could be taken over as input dimensions by another statistical-mathematical model or method. Within the seking techniques, the heuristic methods seem to be so far the most adequate for such problems.

APPLICATIVE ASPECTS[2]

1. Starting from the premise that a high degree of complementariness as regards goods exchanges on the world market is a basic condition in the establishment of solid economic agreements among countries we have tried to come to a digital valuation of the extent to which Romania's foreign trade represents a complementariness in relation to the foreign exchanges carried out by the other CMEA countries. For this purpose, we have defi-

[1] In this respect, we mention the works: I. Georgescu — Elements of Artificial Intelligence, Editura Academiei R.S. România, 1985, Barr A, Reingenbaum, E. — *The Handbook of Artificial Intelligence*, R.T. Press, 1981.

[2] We refer to two studies we have published in Studii și cercetări de calcul economic și cibernatică economică: "Index in valuating the possibilities of compensation in foreign trade", in no 2, 1983; "The SER-EP programme in the analysis of dynamic series for the elaboration of forecasts", in no. 1, 1976.

ned coefficient (2). The data used have been taken over from the Yearbook of International Trade — U.N., 1976 and referred to goods flows.

The principle of complementariness has been considered in the sense that we included into the calculus products on the same level of classification (the third level) expressed in the same measure unit (USA dollars). The coefficient defined by relation (2) presents the grade of complementariness seen in point of the interests of a part (in this case, that of Romania). Resulting are values between 0.53 and 0.223 expressing moderate grades of complementariness between exports and imports of merchandize. The application has outlined some specific aspects too: the possibility to avoid elements of rejection surveying countries for which geographical distances, long-term bilateral agreements, membership to different economic communities present no marked differences; the utility of including into the calculus data for longer periods (2—3 years) for obtaining stable indices not affected by perturbative elements; the need to increase the grade of classifying in detail the flows on groups of merchandize and goods.

2. For the elaboration of forecasts starting from inertial evolutions, we have assembled several methods thus excluding the subjective options that may ocur in various stages in obtaining the forecasts. Among the methods included, we mention: statistical tests, self-correlation, the method of least squares, spectral analysis, the Theil coefficient, the method of exponential levelling. Generally speaking, the system appears as a chain of methods although some of the connexions ensure a certain grade of reciprocity similar to that implied by the Al type complementariness. The compatibility among elements is ensured through the elaborated programme (the seeking system is relatively rigid). The performances of the system of procedures entitled SER-EP satisfy the forecasting demands mainly for processes that are not subject to the risk of major impulse due to a change in the exogenous factors.

FINAL CONSIDERATIONS

Complementariness exists and it is worth taking into consideration since it may represent a "factor of growth". Its existence in various grades of intensity makes measurement necessary in facilitating some objective possibilities of selection, argumentation and decision. The utilization and conscious control of this capacity of the phenomena of maintaining their state, respectively, of growing through the association of the complementary characteristics may be considered stages in achieving the state of harmony. The measuring modalities proposed as well as the afore mentioned possibilities concerning the seeking of the elements that can complete one another are considered to represent an attempt to surpass the establishing stage concerning the existence of complementariness for its utilization in economics and cybernetics.