Some Methods for Developing Economy through Resources' Restrictions in the Contemporary Crisis

Gheorghe Săvoiu

JEL Classification Code: *M11*

1. Introduction

The specific statistical methods of managerial analysis starting from the criteria of energetic, exergetic, entropic and value analysis and restrictions' analysis of the synchronous production are the result of integrating careful statistics and economics with ecological analysis within the contemporary methodical arsenal of the organization's management.

2. The Concise Content of the Specific Analysis' Methods

The methods are indeed fundamental for developing economies through restrictions of the contemporary crisis:

A_1.*Method of energy analysis,* which is based on the method of the energy balance, focuses on assessing the potential of energy conservation,

establishing an optimal level of that potential, and consequently on setting up an optimal managerial decision regarding the conservation of energy by having recourse to coherent measures.

The general equation of a quantitative energy balance is a reflection of the content of the first principle of thermodynamics, which is expressed in a nutshell by the following formulation: "the sum of all the quantities of energy entering (ΣWI) the contour of the flow of executing the product or of the firm's activity (defining energies of every form, expressed in the equivalent of only one form of energy) is equal to the sum of all the amounts of energy coming out (ΣWE) of the same contour: Σ WI = Σ WE . As part of the energy that comes in (ΣWI) two major components are defined, namely the energy effectively entered into the contour from the outside, and the thermal energy generated from the inside through exothermal chemical reactions (when such energies occur effectively); likewise, within the energy gone out (ΣWE) two other significative components are defined, through the effectively used energy, and the energy lost from the contour. The energy used or valued in a useful / efficient manner within the contour of the flow of executing the product is, in its turn, divided in two components, in keeping with the main technological flow, directly generating the product of the firm, and other processes or secondary flows of the firm. Thence several conceptualizations appear[1], useful for making the energy analysis, defined as energy efficiency rate:

1. the global efficiency rate = the efficiently used energy / the energy coming from the outside, and generated within the contour,

2. the internal global efficiency rate = the efficiently used energy in the main technological flow / the energy coming from the outside, and generated within the contour,

[1] Preda, G., Luțu, M., *Management şi know-how. Utilizarea eficientă a resurselor energetice şi materiale,* Editura S.C. *Romcartexim* S.A., Bucureşti, , pp.100-135. (1998)

3. the economic efficiency rate = the efficiently used energy / the energy entering the contour from the outside,

4. the internal economic efficiency rate = the energy efficiently used in the main technological flow / the energy entering the contour from the outside.

The specific consumption (cX) of energy W for executing a unit of product "x", realized in the total quantity Q, is a final indicator significative for the energy balance, defined by the relation:

$$c X = \Sigma W / Q x .$$

A_2. *Method of exergetic analysis* appeared with a view to improving the method of the energy balances, as a means of investigation and calculation having energy and ecological implications. The notions of *exergy*, or usable energy, and *anergy*, or energy of a null capacity of transformation, were introduced by Zoran Rant[1], in the years 1953, and respectively 1963. In a succinct detailed presentation, the mechanical energy and the electric energy contain only exergy, the energy of the ambiant environment – only anergy, while thermal energy contains both exergy and anergy. Exergy evinces the quality of energy, a type of energy being all the more valuable as it contains more exergy. Anergy underlines, in the current stage of scientific knowledge, the lack of the capacity of transforming a certain kind of energy. In general, all the natural processes are irreversible, as they conduce to a qualitative degradation of energy through transforming *exergy* into *anergy*. The energa balance becomes, in keeping with the exergy analysis, a balance between exergy and anergy, through applying the second principle of thermodynamics, which defines the behaviour of both exergy and anergy during the reversible or irreversible processes, as follows:

Axiom I - In the irreversible processes, exergy turns into anergy.

[1] Rant Z.,*Exergie end Anergie*.Wissenschaftliche Zeitschrift der TU Dresden, pp.1145-1149. (1964).

Axiom II - In the reversible processes, exergy remains constant.

Axiom III – It is impossible for anergy to turn into exergy.

The general equation of a exergy balance validates both the principle of the conservation of energy, and the quantitative energy balance (or energy balance proper), and the principle of the degradation of energy during the irreversible transformations, and is virtually identical to the equation of the energy balance, except fort he fact that each component of energy is in turn divided, within the exergy balance, into exergy (E) *and* anergy (A), so that:

$W = E + A$, and $\Sigma W = \Sigma (E + A)$

Thus appear the exergy deficits (ΔE), and the anergy surpluses (ΔA) at the exit from the contour of the flow of execution of the product, or of the firm's activity, the former indicating the size of the transformation's irreversibility, and being equal to the latter within the contour (ΔE) = (ΔA). The ration between the exergy deficit upon going out of the contour, in proportion to the same on entering (ΔE), and the exergy deficit generated within the contour (ΔEg) defines the degree of irreversibility of the energy transformation ($\Delta E / \Delta Eg$). The exergy deficit (ΔE) can be reduced through managerial decisions aiming at thermodynamic improvements of the contour, the rational direction of the energy flows, augmenting the efficienc of the energy transformation rates, and through turning to account the secondary energy resources.

A_3.*Method of the entropic analysis* follows the signification of the second principle of termodynamics, often even called the law of entropy; according to this signification, phenomena in nature are *irreversible*, their sens comes back from the state of order to that of disorder, from the state of imbalance to the state of balance / equilibrium. The acceptations of entropy are variegated, from *thermodynamic entropy* to *statistical entropy*, from *informational entropy* to *social entropy*. Entropy has facilitated the understanding of the processes having to do with

energy, of the losses accompanying any energy transformation, seeking to increase efficiency of turning to account the energy available. The entropic analysis extends the contour of the productive technological flow, also involving the environement, or nature, in a polluting, negative and non-regenerative sense; the product and the packaging become, after use, factors of inceasing the outer disorder. The process of product execution is defined as entropic, or resource-consuming, thus maximizing disorder in the ambient milieu. However, the support of information, or negentropy, appears as being a practical solution by means of extending, through knowledge, the traditional resources available, or via substituting them for new resources.

A_4. *Method of value analysis*[1] [3] or *value engineering* constitutes one of the most interesting specific management techniques, which ensures the necessary balance between the use values projected, and the costs due/appropriate to their execution; they are defined through expressly analysing the product, the function of the product and its use value. Value analysis is a systemic and creative method of analysis and research-planning that, through the functional approach, sees to it that the functions of the product under study are conceived and realized at minimal costs, in conditons of quality that should satisfy the users' necessities in keeping with social-economic demands. The range of the problems related to dimensioning the functions, from both the technical and the economic standpoint, is determinant in value analysis. The correct evaluation of the level to which a function is realized, by means of the characteristic measuring units, is called the

[1] Value analysis developed as a result of an initiative appeared in the 1950s, within the American firm General Electric. The supply director of a medium firm, namely H. Erlicher, remarked that in many cases coming back to the original projects, for which scarce material were provided, was not justified, as the new products functioned as well as the older ones, and especially at much smaller prices. The target of reducing the costs in the conditions of a qualitative level that was at least constant, established as a point of reference, was transmitted as an objective to L.D.Miles, the head of the supply service of the company's divisions, based in Baltimore. Taking into account a number of aspects concerning the costs of the current products, but also the costs of the new products, in 1947, L.D.Miles elaborated a specific, functional and systematic method of management for decreasing costs, which he called value analysis.

technical dimensioning of the product function. The economic dimensioning of the functions presupposes the analysis of the product submitted to value analysis, from the producer's point of view, determining the means or resources consumed for the realization of the product, as well as its cost. In appying value analysis, the following steps are taken in economic practice: the stage of the preparatory measurements, the analysis of the social need, the analysis and evaluation of the existing situation, the conception or re-conception of the product, approval of the optimal solution, the execution, and the checking of the application. Value analysis represents a method having a very special character of generalization. The method of value analysis, or value engineering, can be applied to any product, organization, and even managerial system, going beyond its boundaries, and proving apt to successfully being tailored for the whole social and political system. Value analysis or value engineering imposes a new type of approach in organization management, responding to the components of the system through the intermediary of their functionality, and ignoring managerial procedures, and even the existing organizational structures, built exclusively on productive-constructive bases, which can lead to obtaining spectacular results, to improving the performances of the system, and increasing its economic potential. This brief historical sketch of value analysis emphasizes perhaps one of the most promising specific management methods, in the perspective of an expected resource crisis.

During World War Two, the crisis of such strategic materials as nickel, chromium, wolfram/tungsten and platinum determined the allied governments to prioritize their allotment to the armament industries. Diminuation of resources generated an increase in the ensurance of supply of substitute materials. In order for the product to work properly in the conditions when substitute materials were used, all of them had to be re-designed. The theory of value analysis[1], succinctly

[1] If L.D. Miles used the name of "value analysis", or "search for value", subsequently the Navy Office of the American Fleet used the term of *value engineering* in order to describe value

described by L.D. Miles, presupposed defining the notion of product value starting from the difference of content which that notion involved, for the buyer, and for the producer. For a buyer, the value of a product signified the maximal amount of monetary units that he/she was willing to pay in exchange for the defining attributes of the product, in accordance with the quality characteristics, the conjuncture of the relationship demand-supply, and the prices of the products that concurred them in point of usefulness, or of the similar products offered by the other firms present on the market. Virtually opposed to the value-for-the-buyer, the value-for-the-producer, or the cost value, was defined as the minimal amount of costs by which the respective product can be manufactured. The two notions can merge into only one simple notion, that of value, which additionally implies the conclusion that the value of the product can be augmented either through diminishing the value-for-the-producer, or the cost value, or through increasing the value-for-the-buyer, or multiplied through both variants, cumulated in point of effects. This is, succinctly and in rather general terms, the concept of "value" elaborated at the General Electric Company, which also achieved, over a very short interval, important annual savings. This procedure of analysis of the firm General Electric was taken over by the Ford corporation, after 1958, and then by the companies coordinated by the Department of the USA Air Force, and, subsequently, by an increasing number of American companies, and, beginning with the year 1960, by some European firms. Nearly a decade after the emergence of the method, new extended solutions appeared at General Electric. To begin with, the typology of values was diversified, so the theory acknowledged the existence of four categories of values, namely: use value, estimation value, cost value, and exhange value. The first two categories synthetize the minimal costs necessary in order to configure the

analysis in the design / project stage. Thus, one confusion has appeared, which lasted for a long time. The terms in question are utilized to indicate the stage for which the procedure is applied (i.e. an already existing product, or at the level of product conception/design).

defining functional and psycho-sensorial attributes or characteristics of the product. In estimating quality by means of value, the product is redefined as the ensemble of utilities, and of relationships with its users. The other values, bringing together the production costs, or those recognised through exchange, are evaluations realized not in proportion to the material costs, but rather in proportion to the satisfaction the buyer gets after using the product. A first significant result of the method was that many manufacturers were tempted to use substitute materials. L.D. Miles set up a team made up of specialists coming from various compartments involved in designing a product, with a view to methodically and systematically analysing the value of the designed and manufactured product. In the sixth decade of the last century, H. Erlicher, who had, in the meantime, become the Secretary of the Armed Forces, used his position to extend the method of value analysis. Yet, the method was simultaneously utilized by the USA Navy Office, who initiated a target-programme aimet at reducing the costs of the ships and adjoining equipment, as early as the design phase, which yielded excellent results in the years 1955 and 1956. The year 1956 was in fact the year when value analysis, now alternatively defined as value engineering in the activity of design, substantially developed thanks to the US Secretary of Defence, Robert McNamara. Using value analysis led to eliminating many unjustified costs, in direct proportion to the use value of the product; in only five years, the amount saved rose to something like over $14 million. Value analysis is also defined through a number of fundamental principles:

I. the principle of functional analysis, in keeping with which the functional characteristics are much more important than the structural ones,

II. the principle of the double dimensioning of the functions, namely their technical dimension expressed through specific technical measuring units, and the economic dimension expressed through costs,

III. the principle of the maximization of the ratio between the use value and cost (increasing the product's competitiveness through maximizing the use value in parallel to minimizing the costs),

IV. the principle of the final hierarchization of the product's functions, starting from the simple relation of ordering $S^* = \Sigma S / P$, where S^* represents the average rank of importance, of the individual level of importance S allotted through order numbers, resulting from the number of analysis matrixes of the P type (assigning the level of importance is called up in proportion to the number of functions that define the product)[1]

V. the principle of the systemic approach to use value, as the newly created products, on the whole, respond to certain individual/social needs, but not at any rate their subsets or components parts.

Value analysis is a type of organized analysis aiming at identifying the useless costs in the products having more than one component elements, utilizing *functional analysis* to define the problem, and *group creativity* to solve it.

A_5. *Method of the restrictions' analysis of the synchronous production*, initiated by Goldratt Eliyahu, develops a set of programmes that organize and structure the activities within the economic processes, in the natural hypothesis of the limitation of the resources, tools and materials, machinery and equipment, personnel, and of any other restrictions which can affect the possibility for an organization to realize a certain production programme, thus laying the foundation of a new specific management method, briefly designated by the name of the method of the restriction analysis. One can easily see that nearly all organizations are faced with the phenomenon of of the sense of haste/urgency in realizing the production at the end of the time period allowed by the

[1] Ioniță, I., *Analiza valorii*, Editura științifică și Enciclopedică, București, pp.11. (1984).

contract (called by Goldratt Eliyahu "a hockey-stick", from the graphic aspect of the evolution of the production towards the final part of the period). The cause of the cyclic occurrence of this problem[1], lies in the fact that two different sets of indicators are involved: the initial indicators of norm-regulation of the energy consumptions, (manual) work / labour and materials (of efficiency of the cost accounting, local indicators, which lead to minimizing the number of technological interventions through large lots of workpieces, and also to diminishing deviations from the consumption norms), and final indicators, which refer to the financial performance (theoretically, monetary units/delivered product, but practically in the shape of the net profit, the amortization of investment, and of the flow of cash per product). Thus appears the need for realizing other indicators having an operational character, another set of indicators, which could offer a direction of action: the equivalent value of the sold product, the stocks and the operational costs. The added and realized value is concisely defined as the equivalent value of the sold products, the stocks represent the money that the organization has invested in the products which it/they want(s) to sell, and the operational costs – the money that the organization pays for transforming the stocks into a turnover. The organization's objective becomes treating all three indicators simultaneously and continuously, and this leads to achieving the end of obtaining the money for which provision was made in the order or the contract proper, i.e. it is expressed through increasing the added and realized value, at the same time as the stocks and the operational costs are reduced. Another problem faced by the organization is generated by the deficient capacities, the exceeding capacites, and the resources having capacity restrictions. The notion of deficit capacity is identified, or the appearance of a bottleneck as being the resource the capacity of which is smaller than the demand placed on it, and the notion of excess capacity, or the appearance of a wide spot, as being the resource the

[1] Năftănăilă, I., *Managementul restricţiilor. Sinteză*, Editura A.S.E., Bucureşti, pp 4 –5. (2004).

capacity of which is bigger than the demand placed on it. The conclusions of the analysis are remarkably useful: one hour saved in a tight spot / bottleneck virtually means an extra hour for the entire production system, while an hour saved at a wide spot is but an illusion, which only adds another hour to the idle/inactivity time. Thus, the analysis reveals resources with a restriction of capacity, or resources whose utilization is near to capacity, and so they can become bottlenecks/tight spots if they are not carefully programmed. The time of a complete cycle of executing a product is made up of a number of specific categories, or types of time: the *adjustment time*, a time that a team spend waiting for a resource to be scheduled or accessed, the *access, or resource processing time*, the *queuing time*, while the team waits their turn to come to access the resource, while the latter is busy with another team, the *waiting time*, when the team waits for another team (the subcontracted phase in the product's technological flow) in order to co-generate a certain stage of the project, and the *inactivity time*, as the difference of the duration of the activity cycle and the sum of the four previous times. In analysing restrictions the following notions are also used: *drum*, *buffer*, and *rope*. If the production system contains a tight spot, this is the best ckecking point, and it will be called a drum, because it sets the rhythm in which the rest of the system (or those parts that it influences) works (or "beats"). Putting and maintaining, before the tight spot, a buffer appears as an immediate necessity, in order to permanently ensure something to work on, as the production of this tight spot determines the firm's turnover. Likewise, within the flow, communication will be made upstream, in order to prevent a large stock forming, which would immobilize the firm's money. Communication, called, in a graphical manner, a *rope*, can be formal, in the form of a programme, or informal, coming as free talks.

3. A Final Remark

All the broad classes of methods are ever more frequently structured – in a relatively far-fetched, strained manner – as aggregates of techniques, while the methods and the techniques are increasingly utilized in ever more diverse combinations by the managers, starting from the disadvantages of individual application of any method or technique, from the capacity of homogeneous ensembles of techniques grouped into methods of satisfying multifunctional managerial needs to solve properly the resources' restrictions, even in crisis conditions, up to the permanent desire of managers to achieve methodical and technical improvement or professionalization.

References

Preda, G., Luţu, M., *Management şi know-how. Utilizarea eficientă a resurselor energetice şi materiale,* Editura S.C. *Romcartexim* S.A., Bucureşti, , pp.100-135. (1998)

Rant Z.,*Exergie end Anergie*.Wissenschaftliche Zeitschrift der TU Dresden, pp.1145-1149. (1964),

Ioniţă, I., *Analiza valorii*, Editura ştiinţifică şi Enciclopedică, Bucureşti, pp.11. (1984),

Năftănăilă, I., *Managementul restricţiilor. Sinteză*, Editura A.S.E., Bucureşti, pp 4 –5. (2004).

Gheorghe SĂVOIU, PhD, Associate Professor, University of Piteşti, Romania.