V. PESCARU
Department of Economic Cybernetics
Academy of Economic Studies

The Concept of System in the Process of Improving the Information Systems

Many efforts and intentions to improve the information systems may be compromised because of the lack of a systemic approach of this process. It may seem paradoxical that when speaking about the information system one should overlook just the essential in its improvement — the necessity of a *systemic approach.* In practice, however there are situations of this kind in which because of the lack of an inadequate analysis of the system, either with the desire to solve more rapidly the complex problems of improving the informational systems by using simplistic methods and techniques or through the isolated approach to improving one or several components of a system under the conditions of strong connections between these parts and the rest of the parts in the given system and of the connections with other systems, one deviates from the demand for a systemic approach, which causes the results of the respective efforts for improvement to be inadequate. An isolated "improvement" of a part (of some flows, operations, techniques, etc.) of an informational system which is not brought in accord with the rest of the system, with the demands for a perfect functional compatibilty between all its component elements may rather lead to the appearance of a phenomen of rejection than of one of integration.

1.1. THE CONCEPT OF SYSTEM

The concept of a system is not new. They have long spoken of the solar system, the philosophical system, the juridical system, etc., and in our days also of the economic system, the information system, the planning system, etc.

In all cases, reference is made to a set containing an organic whole, more exactly, suggesting the existence of a set of homogeneous elements and

of a set of connections between these elements. The general theory of the systems is built by setting out from such a definition.

It should be said that the term of a system has not a very exact acceptation as that of a relation, on the one hand, because it refers to most general concepts and, on the other hand, because it is used with no rigorous pretension to definition. This does not matter very much, because, in fact, each time this term is used, the aim is that to outline the complexity and interaction between the component elements as well as their dependence and evolution in time.

The specification of the elements of a system, of the connections between them and of the methods used for their definition is generally done within the analysis of the system. Through the system analysis, there are greater possibilities for stating both the systems as a whole and their component elements.

The first stage in defining a system consists in clearly specifying the aim pursued, the objective of the respective system and the constraints imposed by the necessity of applying the principle of simplification in the definition of systems. Within this stage, the borders of the respective system should also be delimited and to this purpose its connections with other systems should also be specified. If the principle of specification and of simplification is clear at present, the methods of applying these principles are insufficient.

At present, no general theory is known which should offer concrete methods, absolutely rigorous and applicable for guaranteeing the simplification of the systems, the choosing of elements and connections, in the best way, for a given purpose. Hypotheses, experience and intuition are used, to a large extent, in this fundamental domain of the definition of the systems.

In the literature of speciality, great importance is given to this domain of research but, at present, it is the euristic methods which are at the basis of the definition of systems. For this reason, the theory of system analysis has quite rapidly developed of late, offering methods of classification, criteria of establishnig hypotheses, principles of simplification of the systems, etc.

Within the system analysis, from one case to another, one may pursue one of the following objectives: the establishment of the inputs and of the way of their transformation in order to obtain the outputs of the pre-established system; the foreseeing of the outputs of the system when the input conditions are given. In other problems, the input and output conditions of the system are necessary and the structure of the internal elements of the system is required for most efficiently satisfying the specified conditions.

In order to achieve the objectives of the type of those specified above, it is necessary to outline the componet elements of a system, their properties and to establish the connections between them. These can be considered as the main tasks of the second stage in defining the systems.

The functioning of the elements of a system is called the property of transformation and it shows the way in which the outputs are obtained when the inputs are given (Fig. 1.). In particular, the transformation carried out for an element is usually described by a mathematical operator, by a technological process of transformation, etc. allowing to obtain the outputs of an element, by setting out from its input. If the input and transformation process of the element are known, in general, its output can be foreseen. Through generalization, if the properties of transformation are known for

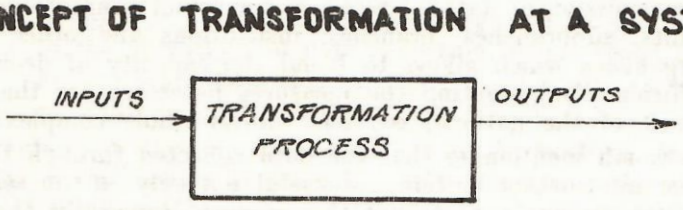


Fig. 1

each element separately, the establishment of a forecast of the outputs of the system becomes possible.

In brief, the notion of element of the system together with the pair inputs-outputs which is attached to it may be exteneded to a set of inputs-outputs and a transformator for the entire system. As a matter of fact, the notion of system is defined as being a set of inputs-outputs [6, 11, 14, 21, 27].

Another important notion in the theory of systems is that of the condition of the system, and it is defined as being the information necessary for establishing the behaviour of the system starting from the considered moment of the condition. Another definition of the condition of the system is given as being the mark attached to a subset of input-output pairs satisfying certain conditions of constancy. Such an input-output subset is considered to be a subsystem. In its turn, any subsystem is a system.

1.2 THE INFORMATION SYSTEM

1.2.1. Definition of the Information System

During the last few years, we have been recording with satisfaction an ever bigger number of articles and works dwelling on problems about the improvement of the informational systems, at the same time, representing an important scientific and practical contribution both to outlining the importance of the informational systems in the contemporary society and to constantly improving these systems. [2, 4, 5, 8, 10, 12, 23]

Confining ourselves only to a few bibliographical sources dwelling on the theme about the improvement of the informational and decisional systems in our country, we can find sufficient elements for elaborating a most complete definition of the informational system, respectively, a definition

from which the indestructible connection between the informational system and the basic system *) should more conspicuously result.

Extremely valuable elements from the scientific point of view which may help us in most correctly defining the informational system can be frequently found in the works of Academician, Professor Manea Mănescu (I).

(I) ... "Being conceived as a means with which reality is contacted in all folds of economic life ..., the economic informational system (... based on scientific methods of collection, processing and transmission of data ...) represents a set of connections between units, subbranches, branches, institutions and other economic organisms which allows to blend the capacity of decision with efficiency in adopting the measures necessary for the management of the national economy in its whole complexity ...

... It is worth mentioning that the data collected through the economic information system are useful not only on the scale of the entire economy, moreover they ensure -especially there where the information network enters the decision making system — at the level of various links — (enterprises, ministries, economic bodies, local party bodies, etc.) the possibility for an efficient intervention in the concrete solving of problems of particular importance ..." [7]

... The information system ... must ensure the exact knowledge, in due time, of realities in society ... It is well known that it is not the simple volume of data that ensures the cognitive value but its capacity of grasping through most synthesic levers the reality, the presence, the conditions and the tendencies of the economic and social phenomena and processes" ...[8].

Analysing these few exemples (I) we can infer both the main tasks of the informational system which we shall try to synthetize in a subsequent definition and the main characteristic elements of this system (man, methods, operations, indices, data flows).

The following can be mentioned as being the tasks of the informational system:

a) Providing, in due time, of an adequate structure and precision, the data necessary for record, analysis and decision at various levels both within the given system (for example, in enterprises) and within the superior hierarchical systems (for instance, group, ministry, county, etc.) for ensuring the maximum efficiency of the activity of the basic system;

b) Comprising the entire activity and the most veridical reflection of reality, of the present, conditions and tendencies of the economic-social phenomena and processes in the given system;

---

* Since any subsystem is a system, in order to outline the relation between the system and its component subsystems, we shall call it a basic system. In the above case, by basic system we mean a unit, an organization, a sector, etc., within which economic-social activities are taking place, specified and delimited through the main objectives and their sphere of action, such as for example: the enterprise, the industrial group, the research-designing institute, the university, the ministry, the commercial organization etc.

c) Ensuring the corresponding informational connections between the structural elements of the given system and the necessary connections with the exterior systems.

In order to extend the basis of analysis and sphere of the elements characterizing the information systems, we shall further apply to a few definitions extracted (II-VI) from the above mentioned reference material:

(II) ... "We mean by information system the totality of methods, techniques and means used in the information process, considered as a set organized and integrated into an organic whole, of the operations of data collection, transmission and processing and of systematization, analysis, storing and turning to account of data" ... [26]

The notion of "*turning to account of data*" resulting from definition (II) as the main purpose of the informational systems also emphasizes the idea about the possibilities for an intensive utilization of the same data (... "systematization, analysis, storing" ...) and for finiding ways to increase the efficiency of these systems. At the same time, this definition is trying to answer the questions: what is the information system? How should this system be organized? What does it operate with?

Important elements which come to complete the answers to these questions are also offered by definition (III) (Dr. Eugeniu Niculescu Mizil) given for the economic information system:

(III) ... "The economic informational system is thus a component of the scientific organization and management of economy and production, which deals in an organized manner with the collection, transmission, selection, storing and processing of data on the economic means and their sources of information, on the economic processes and phenomena, data expressed in value or natural units, at all levels of the national economy" ... [21]

Although, definition (IV) (dr. Paul Constantinescu) is oriented to the enterprise information system, it comes to complete with important specifications the role played by the information system in ensuring the connection between the managed elements and the managing (decisional) elements, at the same time, underlining the role played by man and by the *object of processing* — the *data* — within these systems.

(IV) ... "The informational system of an enterprise represents the totality of means and methods (data, documents, information circuits, processing, data base, etc.) *ensuring the link between the directly productive elements* (managed elements) *and the organization and management* (decisional) *ones*" ... [16]

In definition (V), to be found in one of the papers of professor Vladimir Trebici, the role and place held by man in the information systems is stressed, alongside the modern instruments and means of modelling economic processes and data processing.

(V) ... " In the highest stage of development, an economic information system appears as a *complex of people and practical activities, of equipment and methods*, oriented to the modelling of economic processes with the aid of data processing operations and based on the use of storing and automation means" ... [29]

Some of the definitions given to the informational systems found in the literature of speciality are incomplete because either they do not mention at all or do not emphasize clearly enough, on the one hand, the role and place of man and, on the other hand, the role and place of the data in the information systems. In some of these definitions, the information systems are confined to a set of methods and techniques of data collection, transmission and processing, omitting just the essential elements of these systems: *man*, who plays the important part in conceiving and, afterwards, in most rationally using these systems and the data which represent, on the one hand the object of processing and, on the other hand, the basis of information, analysis and decision-making. If man, who is personally implied in the informational systems (and, it is very difficult to find a single person who should not participate with no matter how small a task in an informational system, for example, of an enterprise) represents the most important element of this system, it should be pointed out that the data, from their qualitative and quantitative points of view, represent the most dynamic element of these systems.

Definition (VI) (engineer N. Costake) conspicuously emphasizes the role played by the data as an object of processing within the information systems, which are dwelt on as processes of transforming the inputs for obtaining the necessary outputs.

(VI) ... " An informational system may be considered as a set processing the input data (data collected from the economic process or from economic units), providing at the output the control data of the economic process, respectively, the data necessary for other economic units". [14].

Synthetising the ideas presented above with a view to finding a most complete definition of the informational system, we consider that the following definition can answer such a requirement:

The *information system* represents the set interconnected by a unitary (systemic) conception of the activities of designing *), collection, recording, transmission, processing and storing of data, achieved by a staff which uses adequate methods, means and techniques for providing in due time, of an adequate precision and structure, the necessary data (synthetic, selected, analytical, etc) at various levels or points of information and /or decision-making; all these activities being subordinated to the aim at ensuring the maximum parameters in the activity of the basic system(economic-social), both within its component elements and as a whole, and within the higher hierarchical structures it belongs to.

---

* By the notion of *designing of data* the author means the activities linked with the determining of the output data and of the necessary input data.

1.2.2. The Cybernetic Character of the Information Systems

Setting out from the definition of a cybernetic system characterized by the possibility of self-adjustment through feedback and analysing this effect in the case of the informational systems, we can notice that these systems have a cybernetic character from two points of view:

a) as an instrument, respectively, as a subsystem of a higher hierarchical system, for example, of the management system and of an executive system and

b) as an independent system with specific objectives, activities, methods, techniques and resources.

The cybernetic character from the first point of view (as an instrument) outlines the position and role of the information system in the information-analysis-decision-making — control circuit.

This aspect more clearly results from the scheme in Fig. 2. taken from one of the works of Academician, Professor Manea Mănescu. **).

In the same work [7] the author emphasizes the close connection between feed-back and the process of improving the informational systems, as follows:

... "The scheme presented (in Fig. 2) is applied to any economy, as a whole, to a branch or economic unit or just to an economic process"...

... "The feed-back may be found throughout the history of society, its intensity growing with the improvement of technology, with the industrial revolution and lately, due to the appearance of modern means of data collection transmission and processing"...

As it results also from Fig. 2. the relation between the social-economic basic system and its information system is one of subordination to the former, to the effect that the information system represents an instrument of statement and control of the activities of the basic system. Life shows that the activities of the economic system change and develop continuously and ever more rapidly and consequently, it has a profoundly dynamic character. Generally, these changes may represent perturbative elements for the informational system, a fact which should be taken into account in the conception, designing and improvement of these systems. Similarly, the information systems should be regarded as dynamic systems in continuous transformation and in full concordance with the dynamic character of the corresponding basic systems.

The outlining of the cybernetic character of the information systems offers us more clarity as to the need of improving them, thus inferring that this technical process of improvement should take place both as regards the close connection with the process of improving the data-analysis-decision-statement and control cycle and from the point of view of improvingo ur own methods, techniques and operations.

From the point of view of the second aspect (as an independent system) the cybernetic character of the information systems is outlined by the existence of their *own* inverse connections acting along the self-adjustment of these systems, and their continous improvement. Fig. 3 presents the feed-back of

---

** Manea Mănescu: "*Preoccupations on the Technique of Elaborating Cybernetic Models in Economy*", Studii şi cercetări de calcul economic şi cibernetică economică, no. 2, 1967. [7]

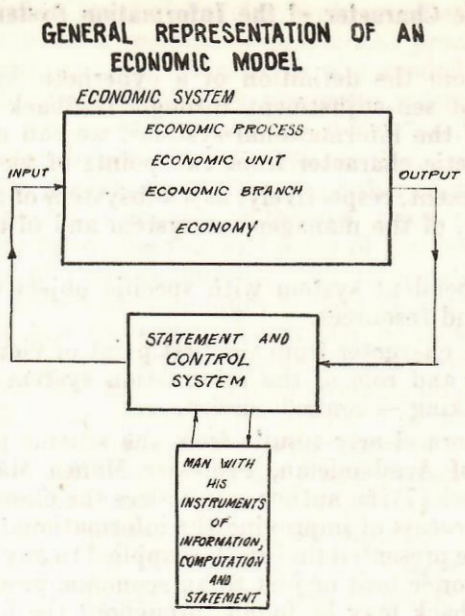

GENERAL REPRESENTATION OF AN ECONOMIC MODEL
ECONOMIC SYSTEM
ECONOMIC PROCESS
ECONOMIC UNIT
ECONOMIC BRANCH
ECONOMY
INPUT
OUTPUT
STATEMENT AND CONTROL SYSTEM
MAN WITH HIS INSTRUMENTS OF INFORMATION, COMPUTATION AND STATEMENT

Fig. 2.

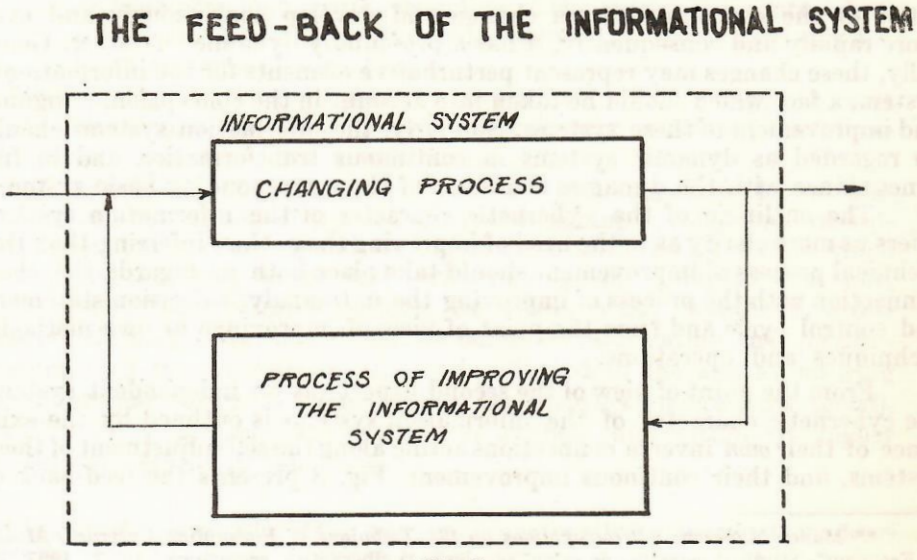

THE FEED-BACK OF THE INFORMATIONAL SYSTEM
INFORMATIONAL SYSTEM
CHANGING PROCESS
PROCESS OF IMPROVING THE INFORMATIONAL SYSTEM

Fig. 3.

the informational system as being made up of its own improvement subsystem. In its turn, the improvement subsystem must imply both the operations of data collection, recording, transmission, processing, etc. (see Fig. 4) and the methodology of designing and improving the informational systems (see Fig.5).

Reasoning on the line of the definition of the concept of system and based on the definition given to the informational system, it results that this system may have a first representation as in Fig. 4, in which the following characteristics are outlined:

— the informational system is functioning under the conditions in which perturbative factors [1] are constantly acting on it, factors generated both inside and outside it;

— owing to the need of the continuous improvement of the information system, it appears as a cybernetic system in which the feed-back (see Fig. 3) is playing the role of selfadjusting its functioning (Fig. 4 outlines the way in which the feed-back acts in the process of improving the informational systems);

— the informational system is considered as a pair of inputs-outputs and as a process of turning the inputs into outputs for which it was built. Its inputs are mainly made up of primary data and the outputs of a processed information obtained following the application of the changing process on the input. In its turn, the changing process, as noticed in Fig. 4. is made up of a set of cybernetic subsystems in which the outputs of each of them become inputs for one or several of them. The transformations of the subsystems are made up of a set of staff ways and means, methods and techniques, which achieve the transformation of the information at the input into processed information at the output from the subsystem. For simplification, only some of the connections existing between the main subsystems of the operating information systems are presented in Fig. 4;

— the general feed-back of the given system has the role of rendering it the value of a cybernetic system with automated adjustment of improvement and organization, behaving as a special adjustment process. The adjustment process, schematically described in Fig. 4. influences the structure of the informational system through its subsystems.

By the improvement and organization of the system we mean both the improvement and organization of its structure and of the relations between the component subsystems.

Fig. 5. illustrates the cybernetic interpretation of the stages found both in the methodology of improving the existent informational systems and in that of designing the new informational systems.

The action of designing or re-designing of the information system, in general, starts with the specification of the outputs of the given system, continues with the establishment of the operators of changing the system and concludes, for the first cycle, with the establishment of the necessary inputs. This first cycle may be followed by another if, for various reasons, the necessary inputs are not available. In this case, the transformation is to be established, through which, by setting out from the available inputs, the necessary outputs

---

[1] By perturbative factors we mean those factors which change the functioning conditions of the informational system at the initially designed parameters or change the existent functioning conditions.

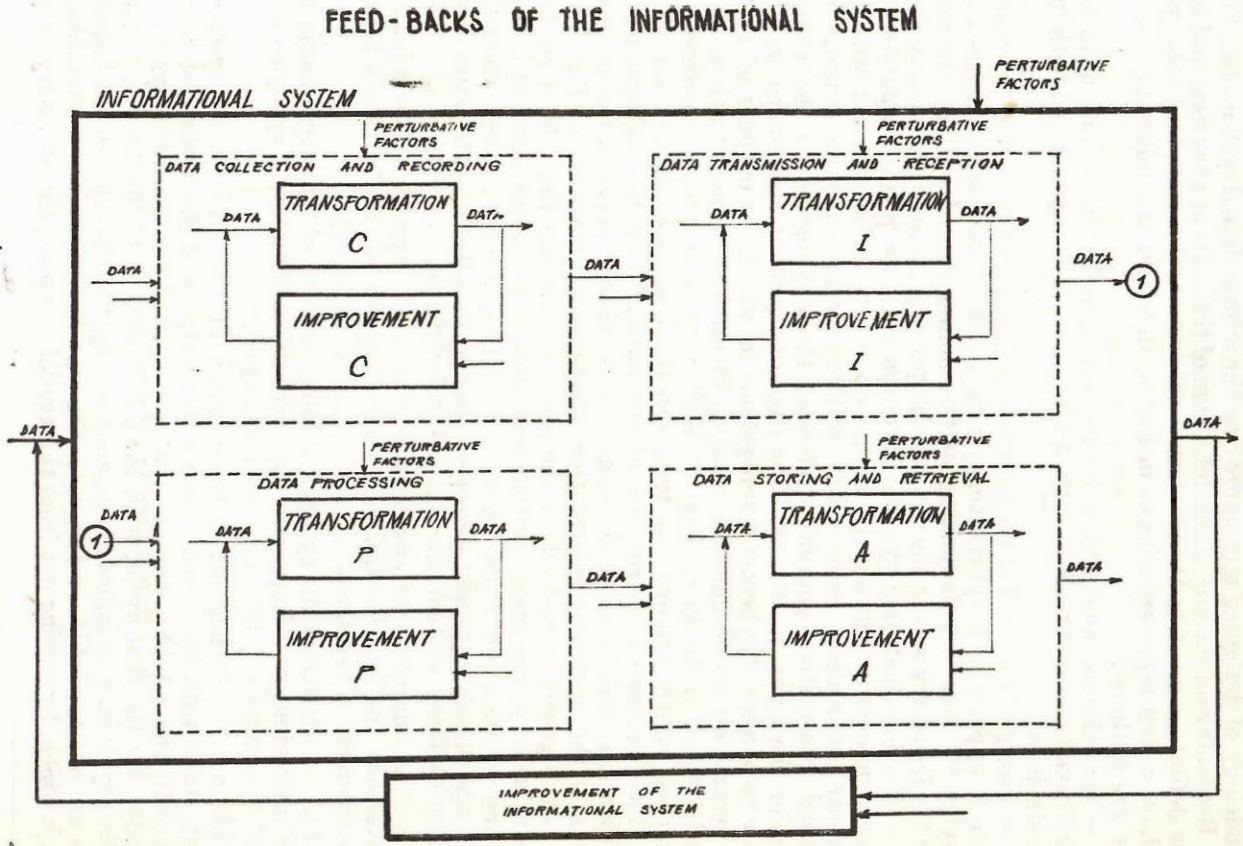

FEED-BACKS OF THE INFORMATIONAL SYSTEM
INFORMATIONAL SYSTEM
PERTURBATIVE FACTORS
DATA COLLECTION AND RECORDING
TRANSFORMATION C
IMPROVEMENT C
DATA TRANSMISSION AND RECEPTION
TRANSFORMATION I
IMPROVEMENT I
DATA PROCESSING
TRANSFORMATION P
IMPROVEMENT P
DATA STORING AND RETRIEVAL
TRANSFORMATION A
IMPROVEMENT A
DATA
IMPROVEMENT OF THE INFORMATIONAL SYSTEM

Fig. 4.

FEED-BACK IN THE METHODOLOGY OF DESIGNING AND IMPLEMENTING THE INFORMATIONAL SYSTEM

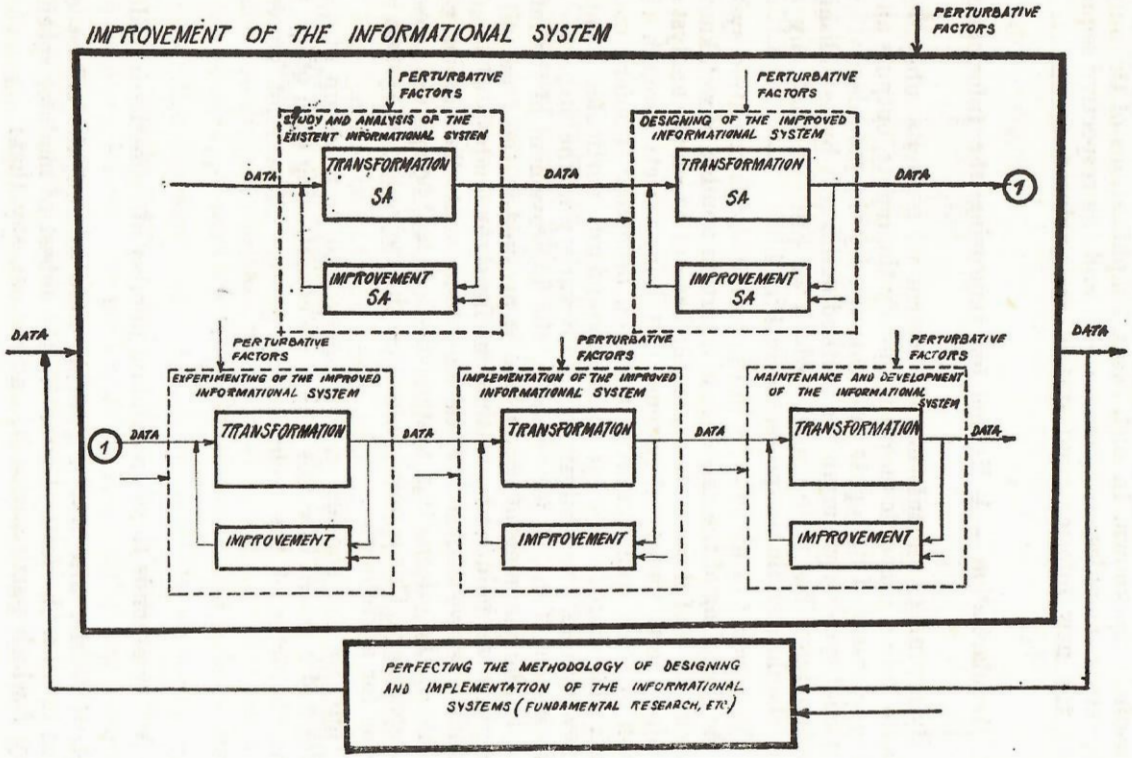


Fig. 5.

are obtained. There are also situation in which, for various reasons, either there are not transforming processes sufficiently performing so as to the obtaining of the desired outputs from the available inputs (for example, there are not sufficiently perfected models, adequate computing technique or the necessary specialized staff), or the possibilities offered by such transforming operators are insuficiently known. In such cases, simplifications of the outputs can be made, certain modules are given up, etc. and the respective sequences of designing the new informational system are analysed again.

1.2.3. **Modularization — A Method for Improving the Information Systems.**

By module of the information system we mean its subsystem; in other words, to define a module means to specify the inputs, outputs and the transforming operator of its inputs into outputs. By the modularization of the informational systems we mean the method defining it by establishing its component modules. The main modules which we consider that any information system should contain are presented in Fig. 4.

The concept of modularity in improving the information systems starts from the accepting of the existence of a certain number of well known modules in the structure of these systems, on the basis of which the analyst creates and maintains a large variety of systems. Obtaining variety through a larger combination of some well conceived modules, becoming standard modules, thus through the reproduction of the non-standard, particular components for each new system, the analyst may limit variety in the structure of the respective system. Thus, if, for example, the improvement of the informational system of the planning of production is pursued in the crude-oil processing branch, this can be done by setting out from the analysis of a refinery or of all refineries, as we shall see. By taking into account all refineries, we can build a module of the information system which should be applied to each refinery taken separately. This is possible because the technological system is generally the same for all refineries.

Thus, we can consider each refinery i to be made up of a set Mi of modules and a set Ri of ratios which are conditioning each other. Due to the specific character of the technological process Mi cannot be void:

$$\bigcap_{i \in N} M_i \neq \Phi \tag{1.1}$$

where N corresponds to the maximum number of refineries-included into the analysis.

As it results also from Fig. 6. we note with M_c the subset of modules common to all refineries and with M_{si} the subset of modules specific of each refinery i which particularize it, and we can say that:

$$M_c = \bigcap_{i \in N} M_i \tag{1.2}$$

$$M_{s,i} = M_i / M_c \tag{1.3}$$

The designing of the information system of production planning at the N refineries would, in this case, consists of designing the modules corresponding to M_c and other modules, M_{si} corresponding to the particular characteristics, the interconnections being determined afterwards.

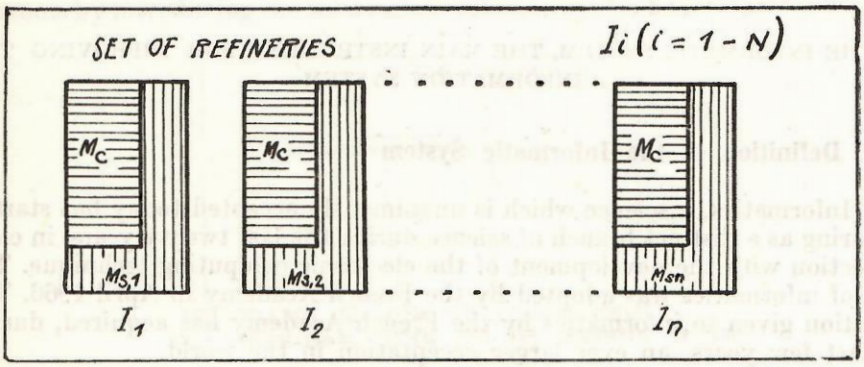


Fig. 6.

This way of approaching the improvement of the information system has many advantages among which we can mention:

a) the modular construction facilitates the reduction of efforts for the designing, implementation, maintenance and improvement of systems, because; the possibility is created for the standardization and specialization of staff;

b) the modules being specified, the connections between them are specified too, a fact which ensures more conditions for ensuring the necessary concordance between the output and input data;

c) the designing of a common module costs less than the designing of all particular modules;

d) variants on the common basic modules can be worked out, a fact which represents a source of supplementary variety of systems (a controlled variety);

e) the possibility increases of introducing and using the necessary economic-mathematical models within the respective information systems;

f) the cost being known, the performances and functioning conditions of each module taken separately, the cost, the performances and functioning conditions of the system as a whole can be easier estimated.

It is known that the maximum variety of the modules and of their achievable combinations is big. For this reason, as part of the improvement of the informational systems, an equilibrium must be established between the variety of the structure of the system and the number of the various, indispensable modules. Generally, the size of the component modules also results from this equilibrium. The bigger the modules, the fewer they are and, consequently,

the variety of the possible interchanges is simplified and thus, greater possibilities exist for maintenance with smaller efforts. [19]

In conclusion, we can say that the establishment of the size of each component module, of the variety and way of their interchange is essential in the activity of improving the informational systems.

1.3. THE INFORMATIC SYSTEM, THE MAIN INSTRUMENT FOR IMPROVING THE INFORMATION SYSTEM

1.3.1. Definition of the Informatic System

Informatics, a science which is unanimously accepted today has started appearing as a distinct branch of science during the last twenty years, in close connection with the development of the electronic computing technique. The term of informatics was adopted by the French Academy in April 1966. The definition given to informatics by the French Academy has acquired, during the last few years, an ever larger acceptation in the world.

"Informatics is the science of rational processing, especially by automatic machines, of information, considered as a support to human knowledge and communications in the technical, economic and social fields". [9]

The informatic system was defined by various authors, in various ways, most of the definitions being given in close connection with the definition of informatics. [8, 9, 12, 13, 23]

As a synthesis of the definitions more often found in the literature of speciality, we suggest the following definition of the informatic system:

The *informatic system* is a technical system of data processing *), preponderently automated, made up of staff, equipment, methods, models, programmes, data files and base, which must satisfy requirements, rigorously specified, of an informational system. [8, 16, 17, 20, 22, 23, 24].

1.3.2. The Relation between the Information System and the Informatic System

It clearly results from the definition of the informatic system that it is a subsystem of the information system. By comparing the definition given to the information system at 1.2.1 with the definition of the informatic system given at 1.3.1., it results that any informatic system may, in its turn, be an information system, but not any information system is an informatic system.

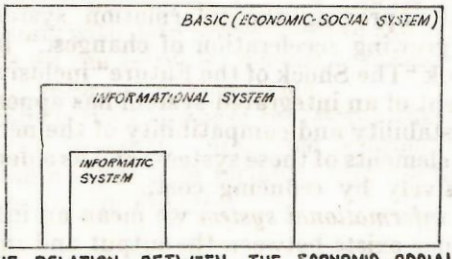
The distinction between an informatic system and an informational one thus consists of the fact that whereas in the information system any data

*) By technical system of data processing, we mean here inclusively the activities of colection, recording, transmission, control, correction, storing, retrieval, etc. of data.

processing means (particularly automatic means) can be used, in the informatic system the data processing must be preponderently automated.

The creation of an informatic system as the subsystem of an information system is obviously an activity meant to improve the informational system. [8, 12, 15, 17, 23].

The process of developing and countinuously improving the information systems by introducing the informatic system may also be interpreted as a pro-



THE RELATION BETWEEN THE ECONOMIC-SOCIAL
THE INFORMATIONAL SYSTEM AND THE INFORMATIC SYSTEM

Fig. 7.

cess of continuous automation of manual and/or mechanized operations and routines of collection, recording, transmission, control, correction, computation, etc., in brief, of the data processing operations.

Just as the basic system (economic-social) includes the information system, as its subsystem, the information system includes its informatic system as a subsystem. In another expression, the informatic system represents the technical-material basis of an information system (see Fig. 7).

Analysing the relation between the information system and its informatic system from the point of view of its sphere, it can be pointed out that the difference between the two systems corresponds to the less organized part of the information system, a part on which the efforts for improvement should be focussed. With the development and improvement of the information systems, by introducing and developing the informatic systems, the spheres of the two types of systems tend to superimpose, especially, through the extension of the informatic ones.

1.3.3. An Integrated Information System

The considerable increase of the volume of data which are to be processed, under the conditions of the continuous reduction of the time for processing these data (following the demand for reducing the time of answer of the contemporary information systems) has led, within those systems which have not applied to the introduction of electronic computers, to the appearance of situations which started slackening the unity of the systems and considerably increasing their cost. These situations were caused especially by the increase in the number of the data processing compartments within the same system,

as a reaction of the respective systems to the pressure exerted by the time factor. And, if such a solution has, to some extent, corresponded to the need of reducing the processing time or of maintaining at the same parameters the time of answer of the information systems, under the conditions of the increased volume of data which should be processed, this solution has, however, led to the considerable rise in the cost of the respective systems (also as a result of the increase of the volume of redundant data), to the appearance of parallelisms and to the slackening of the unitary character of the respective informational systems, which, of course, has negatively influenced their efficiency.

In the process of improving the information systems placed against the background... "of growing acceleration of changes.." in society, as Alvin Toffler calls it in his book "The Shock of the Future" inclusively of the changes in structures, the concept of an integrated system has appeared just as a necessity of defending the stability and compatibility of the necessary connections between the structural elements of these systems and as a demand for increasing their efficiency, inclusively by reducing cost.

By an *integrated informational system* we mean an informational system in which full concordance exists between the output and input data,minimum input data are used for obtaining in due time necessary and sufficient output data and in which the most adequate techniques and means are used (from the economic point of view as well) for the collection, recording, transmission, processing, storing and retrieval of data. [8, 13, 16]

It results from the given definition that under the present conditions of the considerable increase in the volume of data which must be processed, besides the demand for continuouly reducing the time of answer of the informational systems and under the conditions of the existence of the electronic computing technique, the integrated information systems cannot be conceived without having the informatic systems as subsystems. At the same time, the given definition does not exclude the possibility for the existence of integrated information systems under the conditions of the lack of the electronic computing techniques (as a matter of fact, such systems have already existed).

Thus, the activity of achieving an integrated information system is the activity of improving the information system by eliminating parallelism, by reducing redundancies, by minimizing its time of answer and raising its efficiency [16, 17, 18, 24, 25, 28].

Owing to the structural complexity of the informational systems, especially of the informational systems of enterprises, industrial groups, etc., the activity of improving these systems must take place most often modularily, on subsystems, on the basis of a general unitary conception [19].

It results thereof that in the process of improving the information systems, the necessity appears of uniting these modules, these subsystems so that the unitary character of the given system should be permanently ensured in the functioning.

We call an integration process (the obtaining of an informational system by uniting two or several structural elements of this system (activities, modules, subsystems), in the conditions of ensuring a necessary functional compatibility between these elements.

By an *integrated informatic system* we mean the informatic system corresponding to an integrated information system.

This definition accepted, the conlcusion can be drawn that the implementation of an integrated informatic system is possible only in the conditions in which the respective information system is conceived as an integrated system. This acceptation helps us to understand the cause of unsuccessful attemps to implement integrated informatic systems on the structures of some unintergrated information systems.

One of the main instruments of implementing the integration process in the practice of designing the informatic systems, is the automatic data base which represents an efficient means of data processing and the only sources for efficiently providing with data processing and the only sources for efficiently providing with data all the activities necessary for carrying out the objectives of the corresponding informational systems.

The way in which the data base represents the means of achieving one of the characteristics defining the integrated information systems, namely the utilization of minimum input data for obtaining the necessary output data is schematically presented in Fig. 8.

1.4. THE RELATION BETWEEN THE ECONOMIC-MATHEMATICAL MODELS AND THE INFORMATION SYSTEM

The economic-mathematical model represents a set of explicite hypotheses and the set of mathematical ratios existing between them, elaborated in concordance with the phenomenon and characteristics of a certain economic process. It results from the analysis of the very general definition given above to the notion of economic-mathematical model that it represents an image which is the more closer to the examined economic process, as the mathematical hypotheses and ratios between them reflect, more veridically the reality of the respective phenomenon. In this connection, Academician Manea Mănescu outlines the main characteristics of a model, underlining:

..."The models outline the component elements of real phenomenon, at the same time, including the connections existing between them. In this connection, the model simulates reality and it will reflect it the more completely and multilaterally as it includes more of its sides and connections". [1]

The indestructible link between the informational system and the economic-mathematical models used (or necessary to be used) in the respective system can be proved by the following:

a) The Information systems provide the necessary data for the application of models. Within the compulsory stages of the elaboration and use of the economic-mathematical models, we find the tasks of specifying the character, form and structure of data, the obtaining and processing of data for the testing, finalization and application of the model;

b) An economic-mathematical model can be finalized, perfected and applied in practice only through its testing with real data;

c) The information-decision systems use data in the form of results obtained from the implementation of the economic-mathematical models.

---

[1] Manea Mănescu: *Preoccupations on the technique of elaborating cybernetic models in economy.* Studii şi cercetări de calcul economic şi cibernetică economică. no. 2/67.

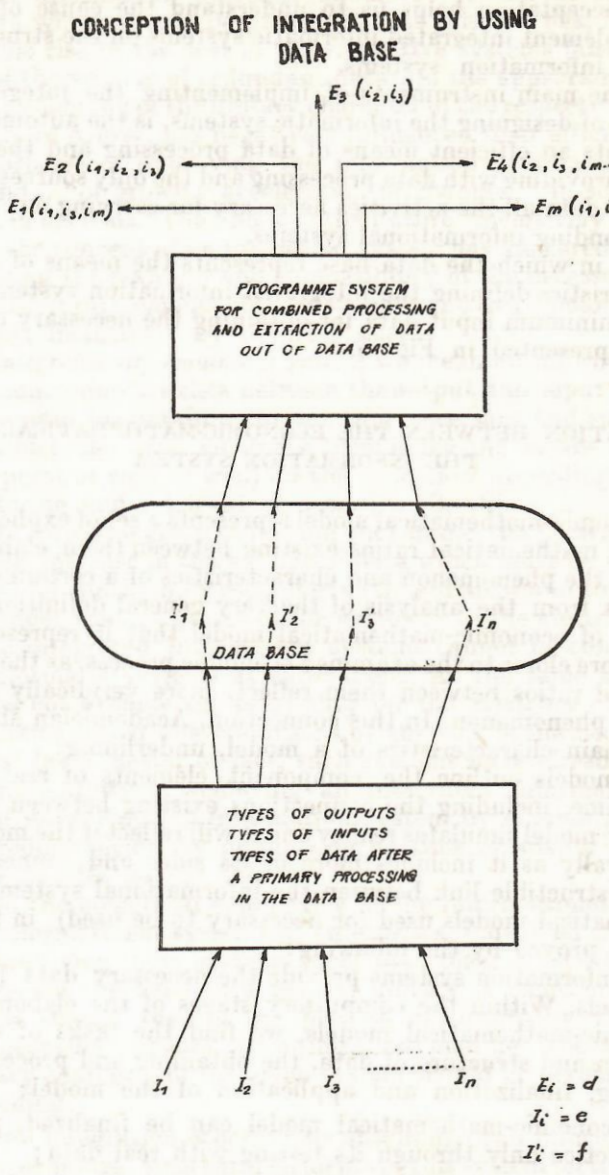

CONCEPTION OF INTEGRATION BY USING DATA BASE
$E_3(i_2, i_3)$
$E_2(i_1, i_2, i_3)$
$E_4(i_2, i_3, i_{m-1})$
$E_1(i_1, i_3, i_m)$
$E_m(i_1, i_m)$
PROGRAMME SYSTEM FOR COMBINED PROCESSING AND EXTRACTION OF DATA OUT OF DATA BASE
I'_1
I'_2
I'_3
I'_n
DATA BASE
TYPES OF OUTPUTS
TYPES OF INPUTS
TYPES OF DATA AFTER A PRIMARY PROCESSING IN THE DATA BASE
I_1
I_2
I_3
I_n
$E_i = d$
$I_i = e$
$I'_i = f$

Fig. 8.

d) The contemporary information systems themselves possess economic-mathematical models and other types of specific models.

Trying to synthetize those mentioned above about the interdependence between the information systems and the economic-mathematical models, the conclusion can be drawn that these models are grafted on the respective informational systems and, the structure and quality of the informational systems are directly influenced by the character and quality of the models used in these systems and inversely. [7, 8]

In practice, within the relations between the economic-mathematical model and the information system, some contradictory aspects may appear, such as, for example: on the one hand, models cannot be be used if we do not have the necessary data, and, on the other hand, we do not know what data are necessary in the informational system for models if we do not have the respective models. There are two possibilities for coming out of this situation:

a) The models should be adapted and used in keeping with the data existing in the system. This method has the disadvantage of substantially reducing the range of models and their number, confining ourselves only to those models which can be elaborated and used on the basis of the data to be found in the existing information systems; at the same time, the accepting of this way leads to the checking of the action of applying some necessary and efficient models, in concordance with the requirements inferred by the present complexity of the economic processes;

b) The informational systems should be improved in concordance with the needs of using the models. We consider it to be the main way which should be followed in the action of improving the informational systems.

The interdependent relation between the informational system and the economic-mathematical models also consist of the fact that their standard of development directly influences the level of professional training of the staff in the respective system, influences the methods of management and planning used, the methods, means and techniques necessary for carrying out the activities of collection, recording, transmission processing and storing of data in the informational system. They influence each other and resulting from this interdependence is the necessity of their improvement in close correlation.

When outlining the interdependence between the economic-mathematical models and the information systems, the interdependence between these models and the informatic systems must be implicitely understood.

The use of modern computation technique in improving the informational system entails its improvement in general (component activities, staff, methods means, etc.). This improvement creates favourable conditions for using economic-mathematical models qualitatively superior to the existent ones, which should much better simulate the economic phenomena and processes of increasing complexity. For this reason, to improve the information system on the basis of the use of modern computing technique also means to create new concrete possibilities for conceiving economic-mathematical models qualitatively superior to the existent ones.

Hence, the conclusions about the profile of the specialists in the field of the utilization of economic-mathematical models and of the improvement of

the information systems by using modern computation techniques. Therefore, the specialists or specialists in the technique of elaborating economic-mathematical models, besides the knowledge of the economic phenomenon they intend to model and of the adequate mathematical methods, must also know the possibilities offered by the existent informational system and the tendencies of its development. Similarly, the analyst designing informatic systems must know the requirements and conditions for the application of the economic-mathematical models. Here, in fact, is the main zone of interference of the specialities of informatics and cybernetics.

In the correlated improvement of the information systems and of the economic-mathematical models, one should also take into consideration the fact that the models are less linked to organizational structures and, to a greater extent they are linked to branches, subbranches, groups of activities, etc. In this last case, the application of models requires information from a chain or network of organizational structures (for example, models of correlation of investments in a branch of the national economy with the necessary resources, models of economic-social development of a zone made up of several counties, models of optimizing metal consumption at the level of the national economy, models of planning the production of an industrial group which comprises several enterprises, etc.), Most often, the information used in a model, for example, at the level of a branch or the national economy, requires data from the basic units as well as their circulation and aggregation on a vertical line within the information pyramid. Such data are necessary to be considered as outputs of the basic units comprised in the respective sphere. If the utility of these data would be appreciated not by the staff at the respective superior level but by the staff of the basic units, they might come to the conclusion that they are useless. It results that for a good functioning of the superior hierarchical systems, a most complete analysis of the system is necessary, which should specify both the requirements of data for the given system and those which are necessary to be obtained outside it. In fact, as it is pointed out in the previous paragraphs, the quality of activity in a subsystem depends also on the quality of the activity in its hierarchical system and inversely.

This is one of the reasons which made us to envisage in the definition proposed for the information system (see 1.2.1) the necessity of providing with necessary and sufficient data both the respective basic system and the superior hierarchical and other external systems.

REFERENCES

1. NICOLAE CEAUȘESCU: *Raport la cel de al XI-lea Congres al Partidului Comunist Român* (Report to the Eleventh Congress of the Romanian Communist Party), Editura Politică, 1974, Bucharest.
2. NICOLAE CEAUȘESCU: *Expunerea la Consfătuirea activului de partid și de stat din ministere și instituții centrale, din 11 aprilie 1974* (Speech at the Conference of the Party and State Active of the Ministries and Central Institutions, of April 11, 1974), Scînteia, April 12, 1974.
3. NICOLAE CEAUȘESCU: *Expunere la deschiderea Colocviului privind problemele științei conducerii societății, din 6 martie 1972* (Speech at the Opening Festivity of the

Colloquy on Problems of the Science of Management of Society, of March 6, 1972), Scînteia of April 26, 1972. April 26, 1972.

4. * * * *Hotărîrea Comitetului Executiv al Comitetului Central al Partidului Comunist Român cu privire la perfecționarea sistemului informațional economic-social, introducerea sistemelor de conducere cu mijloace de prelucrare automată a datelor și dotarea economiei naționale cu technică de calcul în perioada 1971—1980* (adoptată de Plenara C.C. al P.C.R. din 18.IV. 1972). (Decision of the Executive Committee of the Romanian Communist Party Central Committee on the Improvement of the Economic-Social Information System, the Introduction of Management System with Automatic Data Processing and the Endowment of the National Economy with Computation Technique in the 1971—1980 Period (adopted by the Plenary Meeting of the Central Committee of the Romanian Communist Party of April 18, 1972).

5. MANEA MĂNESCU: *Modelarea economico-matematică* (Economic-Mathematical Modelling) Contribuții la dezbaterea problemelor teoretice ale economiei socialiste, vol. 2, Editura Politică, Bucharest, 1971.

6. MANEA MĂNESCU: *Considerații privind aplicarea principiilor ciberneticii în economie* (Considerations on the Application of the Principles of Cybernetics in Economy), Studii și cercetări de calcul economic și cibernetică economică, no. 5, 1968.

7. MANEA MĂNESCU: *Preocupări cu privire la tehnica de elaborare a modelelor cibernetice în economie* (Preoccupations on the Technique of Elaborating Cybernetic Models in Economy), Studii și cercetări de calcul economic și cibernetică economică, no. 2, 1967.

8. MANEA MĂNESCU: *Utilizarea metodelor economico-matematice și a tehnicii electronice de calcul, imperative al perfecționării activității de planificare* (The Utiliztion of Economic-mathematical Methods and of Electronic Computing Technique, an Imperative Demand for Improving Planning), Caiet de lucrări, no. 4, C.S.P., 1973.

9. ARSAC J.: *Informatica* (Informatics), Editura enciclopedică română, 1973. Bucharest.

10. BOLDUR G.: *Informația și decizia în procesul conducerii social-economice* (Information and Decision-Making in the Process of Social-economic Management), Știința Conducerii Societății-Studii, Editura Politică, 1971, Bucharest.

11. BÎRLEA S.: *Conducerea științifică și industria modernă* (Scientific Management and Modern Industry), Conducerea științifică a întreprinderii, Studii, Editura Politică, 1970, Bucharest.

12. BÎRLEA S.: *Sistemul național de informatică și conducere-instrument important în procesul de perfecționare a conducerii și organizării vieții economice și sociale* (The National System of Informatics and Management — an Important Instrument in Improving Management and in Organizing the Economic and Social Life), Contribuții la dezbaterea problemelor teoretice ale economiei socialiste vol. 2, Editura Politică 1971, Bucharest.

13. COSTAKE N.: *Conducerea integrată a producției* (Integrated Production Management), Viața Economică, no. 32, (414), 1971.

14. COSTAKE N.: *Noțiuni de bază în teoria sistemelor informaționale* (Basic Notions in the Theory of Information Systems), Studii de statistică, Debates of the 6th Scientific Meeting of DCS, D.C.S., 1969.

15. CONSTANTINESCU P.: *Sistemele informatice în procesul conducerii* (The Informatic Systems in the Process of Management), Era Socialistă, no. 4(12) 1972—

16. CONSTANTINESCU P. ZAHARIA N.: *Inițiere în organizarea și proiectarea sistemelor de conducere cu mijloace de automatizare* (Initiation into the Organization and Designing of Management Systems with Automation Means), Editura Tehnică, 1972, Bucharest.

17. FEDORENKO N. P.: *Integrirovannie sistemî obrabotki dannih, izdatelstvo.* "NAUKA" 1970, Moscow.

18. MC. CARTHY F. J., MC. CARTHY J. A., HUMES D.: *Sisteme integrate de prelucrare a datelor* (Data Processing Integrated Systems) — translated from English. Ed. Tehnică, 1969, Bucharest.

19. MÉLÉSE J.: *L'analyse modulaire des systèmes de gestion A.M.S.* Editions Hommes Techniques, 1972.

20. NICOLAU E.: *Omul între două infinituri* (Man between two Infinites), Editura Politică 1972, Bucharest.

21. NICULESCU-MIZIL, E.: *Cibernetica şi aplicaţiile ei în tehnica şi economia industriei* (Cybernetics and its Applications in the Technology and Economy of Industry), Editura Academiei R.S.R. 1973, Bucharest.
22. PESCARU V., *Obiectivele concepţiei şi realizării sistemelor informatice economice* (Objectives of the Conception and Implementation of the Economic Informatic Systems), Studii şi cercetări de calcul economic şi cibernetică economică, no. 3, 1972 (and in Probleme ale perfecţionării organizării şi conducerii economiei şi vieţii sociale no.7/1972, IDT.)
23. PESCARU V., *Sistemele informatice — cale a perfecţionării sistemelor informaţionale* (The Informatic Systems — a Way for Improving the Information Systems), Conducere decizie no. 3/1973, Centrul de informare şi documentare în ştiinţele sociale şi politice.
24. PESCARU V., HOMESCU R., APOSTOL C., *Analiza şi proiectarea sistemelor de informatică economică* (Analysis and Designing the Systems of Economic Informatics). The Academy of Economic Studies (a lythographed course) 1971—1974, Bucharest.
25. PESCARU V., CATONA I., POPESCU C., *The Organization of Data Base in the Conception of an Integrated Informtic System at an Enterprise in the Chemical Industry. Economic Computation and Economic Cybernetics Studies and Research no. 4*, 1972 Bucharest.
26. PINTILIE C., *Despre sistemul informaţional economic* (*On the* Economic Informational System), Sistemul informaţional economic, vol. II, IDT, 1968, Bucharest.
27. STARR M. K. *Conducerea producţiei, Sisteme şi sinteze* (Production Management, Systems and Syntheses), translated from the American literature, Editura tehnică, Bucharest, 1970.
28. SMĂRĂNDESCU V., *Contribuţii la definirea sistemului informaţional — decizional integrat ca factor al procesului de conducere* (Contributions to Defining the Integrated Information-Decisional System as an Element of Management), Studii şi cercetări de calcul economic şi cibernetică economică, no. 1., 1974.
29. TREBICI V., *Rolul informaţiei economice în conducerea şi planificarea economiei* (The Role of Economic Information in the Management and Planning of Economy), Evidenţa contabilă no. 1, 1968.
30. VAN COURT HARE, *L'analyse des Systèmes — outil moderne de gestion*, Dunod, 1972, Paris.