ŞTEFAN BÎRLEA
M. PETRESCU

Computer Networks and Information—Processing Systems in the Economic and Social Management

"The socialist society, which people are consciously building, starting from the scientific Marxist-Leninist world outlook, is deeply interested in utilising the achievements of science, with a view to developing economy and culture, for the multilateral flourishing of human personality".

N. CEAUŞESCU

GENERAL ASPECTS

The incidences of contemporary technical-scientific revolution with economic activities determines a deep process of metamorphosis in the traditional economic environment, all over the world. This is particularly powerfully felt both on the level of technology and in the field of management activity.

It is almost unanimously agreed upon by specialists, that present-day management activity radically differes from that of the past and that the personality of the traditional leader of an enterprise or economic organization should be replaced by a modern "managerial" mechanism. Consequently, the principle of participation management is massively penetrating in the most varied fields of economic and social life.

The new approach of management is blended with a great exchange of working methods and techniques, the definition and analysis of problems, information collecting and processing, the construction of a conceptional model, its handling, the analysis of results — all these have deeply penetrated into the management process and become ever more its compulsory stages.

As we are of the opinion that changes determined by the impact between science and technology, on the one hand, and management activity, on the

other hand, will evolve in the future decades increasingly fast, we devote the present communication to the influence of information processing on management and managerial structures.

INFORMATION SYSTEMS, INFORMATION-PROCESSING SYSTEMS AND CYBERNETIC SYSTEMS IN ECONOMY

According to a wide consensus of scientific researchers in the field of management, any management process presupposes the cycles information-analysis-versions-decision-action-information.

As may be observed, this cycle applied to any real system begins and ends with an information process.

It is known that since immemorial times human society has possessed information systems on the evolution of activity and of other domains. Information systems were continuously perfected and developed. Gradually, the previously described cycle was unitarily maintained only in irreducible economic systems (working sites) and became independent activities in the others.

Actually, at the working site of a single individual, the above cycle has as unique support his capacity for information, analysis and decision (completed, at most, by elementary technical means). If the working process involves two persons, the framework of the cycle becomes considerably more complex. There occurs the channel of information circulation between two persons and as such the analysis and decision-making capacity of their ensemble is sensibly increased. At last if a greater economic activity is implied, involving, for instance, n working sites whose activities are in interdependence, the information process becomes very complex, comprising technical means and people whose unique task is to carry, keep and even process information. Consequently, the information systems of economy made up self sufficient systems, involving an ever greater number of activities and specialized cadres.

In the course of time, these systems integrated ever more advanced technical methods and means, culminating in the last decades with the introduction of electronic computers.

The impact between traditional information systems and the electronic computer —one of the most outsanding technical creations of the XXth century — has determined the appearance of information-processing systems.

Information-processing systems implement computation technique in the process of economic management and organization, considerably facilitating the cycle information-analysis-decision-action-information.

Parallelly, at the same time with the processing of an ever more important amount, the sphere of decisions is considerably widened. Consequently, this process — which is supposed to occur with even greater intensity in the following decades, — creates premises for decisions to refer to economic and social phenomena of an ever greater scope.

Obviously, the wider the scope of the decision, the less probable the fact that its adoption be incumbent on a single person, and consequently the participative management becomes imperative.

From the standpoint of the presence of a decision-making function in a system of economic management, it is necessary to delineate the scope of information-processing systems, on the one hand, and cybernetic systems, on the other hand. In our opinion, an information-processing system is transformed in a cybernetic system, when it involves means of decision adoption and application. In other words, the global cybernetic character of an information-processing system is present when it may ensure the development of the whole cycle information-analysis-versions-decision-action-information. Cybernetic systems in the economy are using at present, for the most, for management, conventional technical instruments; yet, it is doubtless that at the beginning of the following century, cybernetic systems in the economy will massively include systems of automatic data processing.

That is why cybernetics, information-processing and computation systems have been lately included among problems of interest for wide circles of specialists and managers of the economy and state apparatus.

Figure 1 shows an attempt to present the relationships between traditional information systems and information-processing systems by implementing the computation technique, so that a permanent feedback be ensured between the economic system submitted to control and the system of analysis and decision *).

The presented diagram points to the fact that the fundamental attributes of management—foresight, organization, action initiation and guiding, as well as control — acquire new valences by the information-processing systems.

The cybernetic systems of the economy maintain the fundamental characteristics of cybernetic systems and present two categories of distinct activities: effecting activities, from system A of figure 1, and guidance activities, effected by system B.

The phenomenon of internal control — an objectively necessary requirement for the operation of cybernetic systems—is achieved in the presented model according to a generalized transfer function, based either on a previously established development program, or on decisions resulting from interconnections between the described systems and other systems.

Going on with the presented reasoning, concerning the interference between cybernetics and information processing, we are of the opinion that in the activity to be carried on in the future by mathematicians and economists, a large part will be held by the operational description of economic activities. We refer more particularly to the finding of adequate solutions for transposing the notion of "transfer function" from the field of automation into that of economic cybernetics.

This approach of the problem is substantiated by the hypothesis that any economic activity — either at the level of enterprises, or of economic branches, or possibly on a national scale — has the characteristics of operational structures, to which certain transformation operators are specific, from a mathematical standpoint.

---

*) The concept of feedback is extended to economic systems in numerous papers by professor Manea Mănescu, to whom the authors express their sincere gratitude for the interesting discussions and imparted ideas.

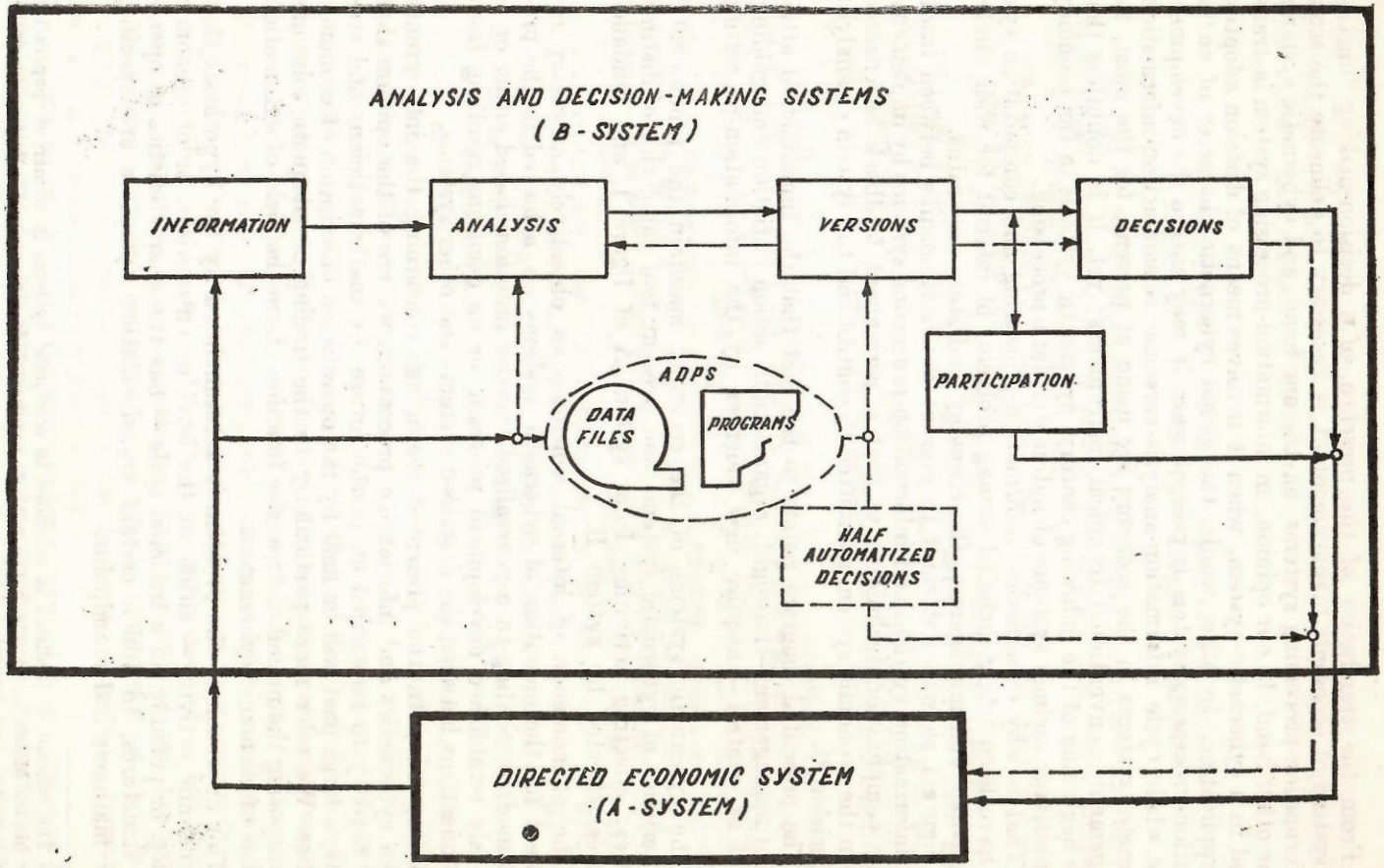
ANALYSIS AND DECISION-MAKING SISTEMS
(B-SYSTEM)
INFORMATION
ANALYSIS
VERSIONS
DECISIONS
ADPS
DATA FILES
PROGRAMS
PARTICIPATION
HALF AUTOMATIZED DECISIONS
DIRECTED ECONOMIC SYSTEM
(A-SYSTEM)
Economic information system
Information-processing system
Information transfer point
ADPS - Automatic Data-Processing System

Fig. 1

In this light, the translation into economy of the relation between input and output signals of any system, involves a transfer function, whose complexity depends on the level of the respective economic system.

MACROECONOMIC OPTIMIZATION

Previously made observations on information-processing systems are based on the fundamental idea of introducing systems of data computation and processing as auxiliaries of the human intellectual activities.

In this context, it is envisaged to pass to the mass solving of the question of optimizing the use of resources on a macroeconomic scale. We agree to the opinion that the optimization question will become a central concern of the managerial activity, with results of high economic efficiency, to the end of the century.

The techniques and methods created of last — which are supposed to greatly evolve in the future — will enable the gradual raising of the optimization level. It is known that at present the optimization processes of resources are generally occurring in effecting units (of production, research, commercial, etc.).

This problem is obviously posed in a different way in the economies based on the free market and in those based on the system of centralized planning. We consider, however, that as time goes on, optimization processes will rise at the level of effecting units and branches, gradually involving high-scale economic and social activities. This preoccupation will determine not only the enriching of the working means and techniques, but also a fundamental reevaluation of concepts concerning information-processing systems.

In our opinion, we shall witness the appearance of ever more connections between computation systems, which result in the gradual creation of integrated networks of these systems (networks of computers).

The concept of information-processing system will imply in the future the compulsory association of the notion of economic and social management. We shall consequently be faced with systems at the level of economic micro- and macrostructures, making an ever wider use of cybernetics methods and techniques. A part of these systems will gradually carry on also the automatized execution of some decisions.

Under these conditions, the interconnection of information-processing systems and their tendency to cybernetization will determine, in our opinion, the appearance of a new type of systems based on computer networks, which will organically integrate also the management activity, on various steps. These systems will be provisionally called management information-processing systems.

Management information-processing systems, thus conceived, presuppose the conscious participation of man in the process of economic decision-making at all levels where the previously described general management cycle is closed.

If this cycle is associated to a computation capacity and a conventional working way, each of the component subsystems of a management

information-processing system has a selfcontrol capacity within certain limits. It results, hence, that if it is taken isolatedly, a subsystem component of a management information-processing system may always be considered as a cybernetic system.

In this connection, in our opinion, the 20th century will witness the integration of management and partial automation of some decisions. First computation systems will be interconnected, which serve different decision-making levels, with a bidirectional information circulation, with the possibility to automatically store and retrieve certain information and to automatically work out certain decision versions. Yet, in principle, the selection of the version — in fact, the decision making —, the following up of its carrying out and possibly its correcting throughout application will always be incumbent on the management body which controls the totality of the respective system.

This last hypothesis enables us to make a special mention on the scope and achievement possibilities of management information-processing systems. The interconnecting of computation systems is theoretically possible — and probably in a more distant future it will be achieved — among all technical systems serving a management activity. The economic and social structure, the intervention capacity of the management mechanism — be it state or private — on a certain activity domain or sector — are obviously exerting a direct and decisive influence on the technical structure and general organization conception of management information-processing systems.

In our opinion, socialist economy based on the social ownership of production means, as well as the unitary guidance of the whole economic and social life permits to create in the best conditions a technical support of maximum efficiency for the integration of the management activity.

We agree that management information-processing systems, based on the interconnection of a high number of computation systems, may be achieved even before the end of the century, in numerous countries of the world, irrespective of their social-economic system. They will facilitate and considerably increase the efficiency of management and social organization mechanism on a national scale.

TYPES AND STRUCTURES OF THE MANAGEMENT INFORMATION-PROCESSING SYSTEMS

Though not aimed at an exhaustive discussion, the previously made observations determine us to point out that management information-processing system should always involve an integrated ensemble of equipments, methods and techniques for collecting, processing, analysing and transmitting information meant for the attention of a previously settled management effort.

The integrated ensemble which we have in mind may form micro-or macrosystems. In our outlook, microsystems generally gather a main computation system, satellite and terminal systems, whose scope refers to the activity of an economic organization *).

*) This definition of the information-processing microsystem obviously refers to the integration of management functions in an evolution process. This process will probably be decisively influenced in the following decades by technical improvements, especially in the field of information collection and transmission, as well as of basic and application software.

An ensemble of information-processing microsystems, defined by objectives aimed at achieving a managerial effort, will be conventionally considered a macrosystem. Macrosystems, in their turn, may be associated, generating large-dimension information-processing assemblies. As an example we cite the management information-processing system, based on a nationwide computer network.

From the standpoint of the role exerted in the management activity, micro-and macrosystems may be: *functional* (systems aimed at exerting one or more of the basic attributions of management (prognosis and planning), coordination, control, personnel policy, etc.), *autonomous or specific* (systems exerting a specialized function: transport, energy supply, etc.), *territorial* (interconnecting information-processing systems from a well established territory), *departmental* (systems ensuring the information-processing servicing of an economic sector or branch), as well as other systems, as those meant for scientific computation, information and documentation, external relations, etc.

Figure 2 schematically presents a process of economic macromanagement, using the relationship between information-processing micro- and macrosystems. As may be seen, the process of information analysis (*A*) is based on information-processing systems of the above described type, as well as on the concentration of a high volume of economic data in a central data bank. The process of version and program working out (*B*) is based on previously made information analysis, on orientations and restrictions dictated by the leading mechanism, as well as on the general condition of economy functioning at different moments. Besides, suggesting partial automation of decision-making, circuit (*D*) is introduced, able to transmit decisions and to automatically record them. The guiding mechanism (*C*) directs the development of economy, based in its own elaboration and on outer information activities. It transfers decision-making to economic micro- and macrosystems as well as to other systems. The distribution of tasks after central decision-making as well as their follow-up is achieved by means of the subsystem (*E*).

The scheme — accordingly to its cybernetic conception — involves a great number of circuits which are exclusively closed by means of the mechanism *C*. The transfer function of the system *C* decisively influences each of the other elements involved in the scheme.

FUNCTIONS AND PRINCIPLES OF MANAGEMENT INFORMATION PROCESSING SYSTEMS

According to the above presented observations, the systems of information processing for the management fulfill the following main functions:

— informs — periodically or on demand — the respective management body on the evolution of economic and social phenomena as well as on the way to apply adopted decisions;

— collects, processes, synthesizes and stores information with a view to working out and substantiating variations on decision-making as well as on the partial automatizing of certain decision;

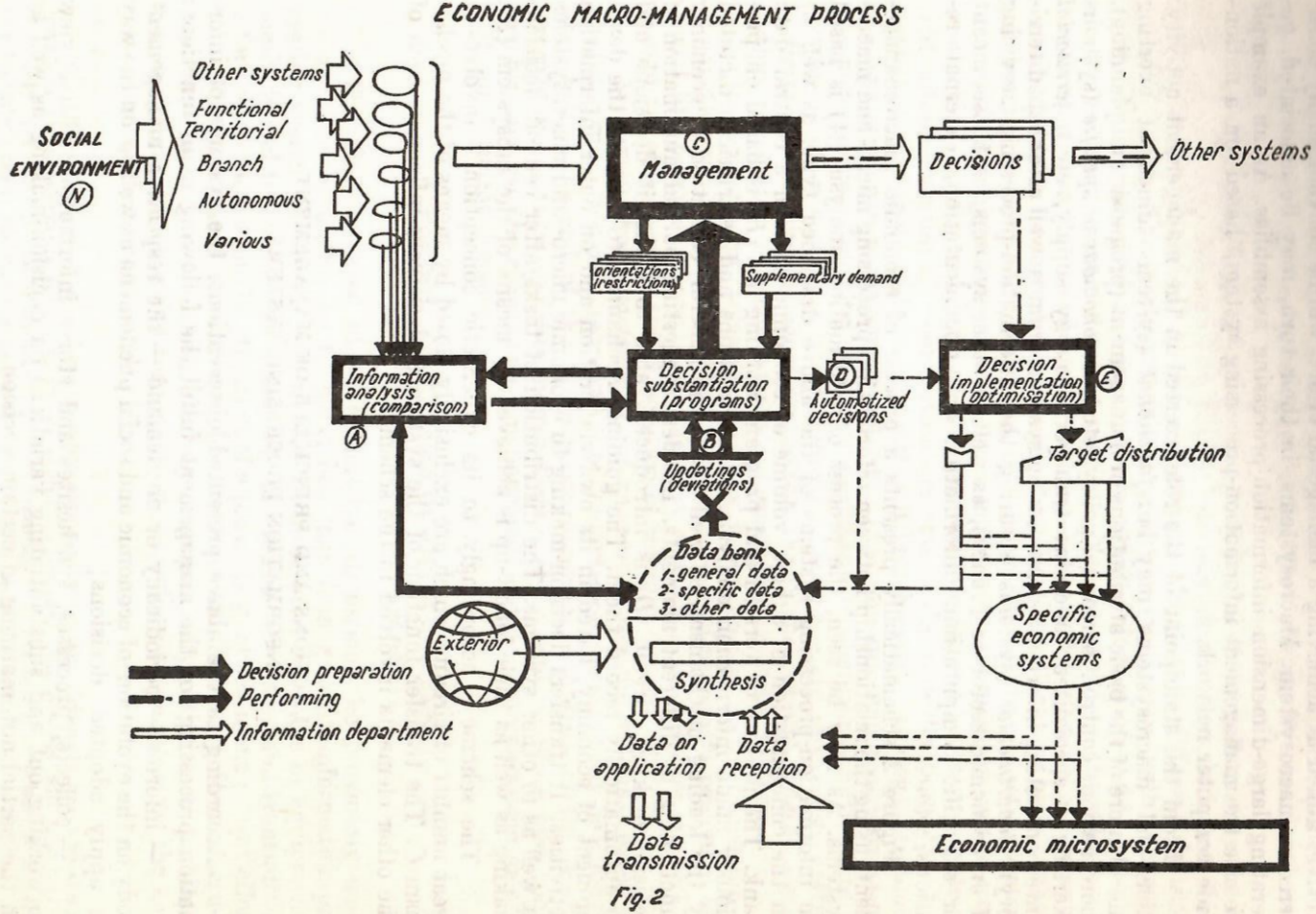
ECONOMIC MACRO-MANAGEMENT PROCESS
Other systems
Functional
Territorial
Branch
Autonomous
Various
SOCIAL ENVIRONMENT
N
C
Management
Decisions
Other systems
orientations (restrictions)
Supplementary demand
Information analysis (comparison)
A
Decision substantiation (programs)
B
D
Automatized decisions
Decision implementation (optimisation)
E
Updatings (deviations)
Target distribution
Data bank
1- general data
2- specific data
3- other data
Exterior
Synthesis
Specific economic systems
Decision preparation
Performing
Information department
Data on application
Data reception
Data transmission
Economic microsystem

Fig. 2

— stores information in data banks and implements the automatic retrieval of data with a view to satisfying the operative requirements of management.

The categories of functions which are going to be considerably extended, may be exerted with corresponding efficiency if the following principles substantiate each system of information processing for management — regardless of its scheme;

— the management of effecting activity should be integrated in a system with a structure of its own, independent of organizational changes;

— the information should be collected only once and circulated on a very limited number of information channels;

— technical-economic indicators and decision-making data of any nature should have a unitary content in all component subsystems;

— data extracting from systems should agree with the competence and responsibility of management bodies at different hierarchical levels;

— the computation capacity should be high enough to ensure data collecting, transmitting and processing, according to the general restrictions imposed in system operation; besides, the storage capacity of data should permit to maintain unaltered information, as far as its utilization is possible by means of rapid information storing and retrieval systems.

COMPUTER NETWORKS

The technical support of information processing systems is made up by computer networks. As the whole conception is based on the development of principles and methods for networks use, we shall further make some considerations on their evolution in the following decades.

The systems of "time-sharing" computation which have considerably grown in the last decade, represent — in our opinion — the embryon which will further result in great networks of data-processing systems. Though very recent, the present-day conception on the organization and technical characteristics of such networks permits to foresee the existence of large-scale data-processing systems meant for economic activity management, by the end of this century.

Forthcoming years will doubtlessly elucidate the nature of functions to be fulfilled by great computation networks, their optimal structure, the processing and transmitting equipments to be used, as well as the suited software, to be available.

It may be already asserted that electronic computer networks, interconnected for economic process management, should largely observe the principle of common use of the resources of all component systems (software, data, hardware). In such a network, any local program will, as a rule, have the possibility to resort to the resources of any component computation system of the network, similarly to a subroutine. Such a network permits the acceleration of decision working out at different management levels — an acceleration based on a rapid, accurate and up-to-date information in real time. Besides, it will avoid the redundant construction of "software" and of data files in different local zones of the economic system, as well as the resulting supplementary expenses.

The technical particularities of a large data-processing network will be determined by the research and design activity, initiated in several countries, Romania included.

We should like to point out that, in our opinion, special attention has to be paid to the possibilities of information introduction and extraction. Account is to be taken of the necessity of an accurate contact between the human factor which measures and guides economic processes, on the one hand, and the technical systems comprised in the network, on the other hand. Taking into account the necessity of an interactive contact, we consider that one of the interface equipments most frequently met between management and the electronic computer network will be the visual-display and graphic-input console.

It is obviously necessary that these equipments should meet the exigency of efficiency and speed, currently applied in the field of economy management by automatized means.

SOME PROBLEMS CONCERNING THE REALIZATION OF AN ELECTRONIC COMPUTER NETWORK IN THE SOCIALIST REPUBLIC OF ROMANIA

In our country, particular emphasis is laid on the field of perfecting economy management. The Romanian Communist Party, the leading force of our society, has widely discussed the problems of perfecting the mechanism of management and social organization, in the last two congresses.

"The socialist society consciously constructed by people, starting from the scientific Marxist-Leninist world outlook — said President Nicolae Ceauşescu — is highly interested in using science achievements, in view of developing economy and culture and of the multilateral flourishing of human personality".

The development of information processing and its use in the activity of economic and social management — resulting from these concerns — has held a central place these last years in the totality of actions undertaken by the Party.

In 1967, the first program for supplying economy with computation and data-processing equipments was adopted. This program substantiated the transition to the use of modern computation technique in the activity of economic management.

Starting from the general development model of Romania's economy, our specialists came to certain conclusions on possibilities of achieving a national system of information processing for management, to be briefly presented as follows.

The structure and total conception of such a system are synthetically expressed in figure 3.

As may be seen, a first category of systems is made up of *information-processing systems of common use*, involving activity groups of management processes at a macrosocial level, such as: the working out and following up of economic and social development programs, finances and currency circulation, home and foreign trade, supply and sale of products, economic, scien-

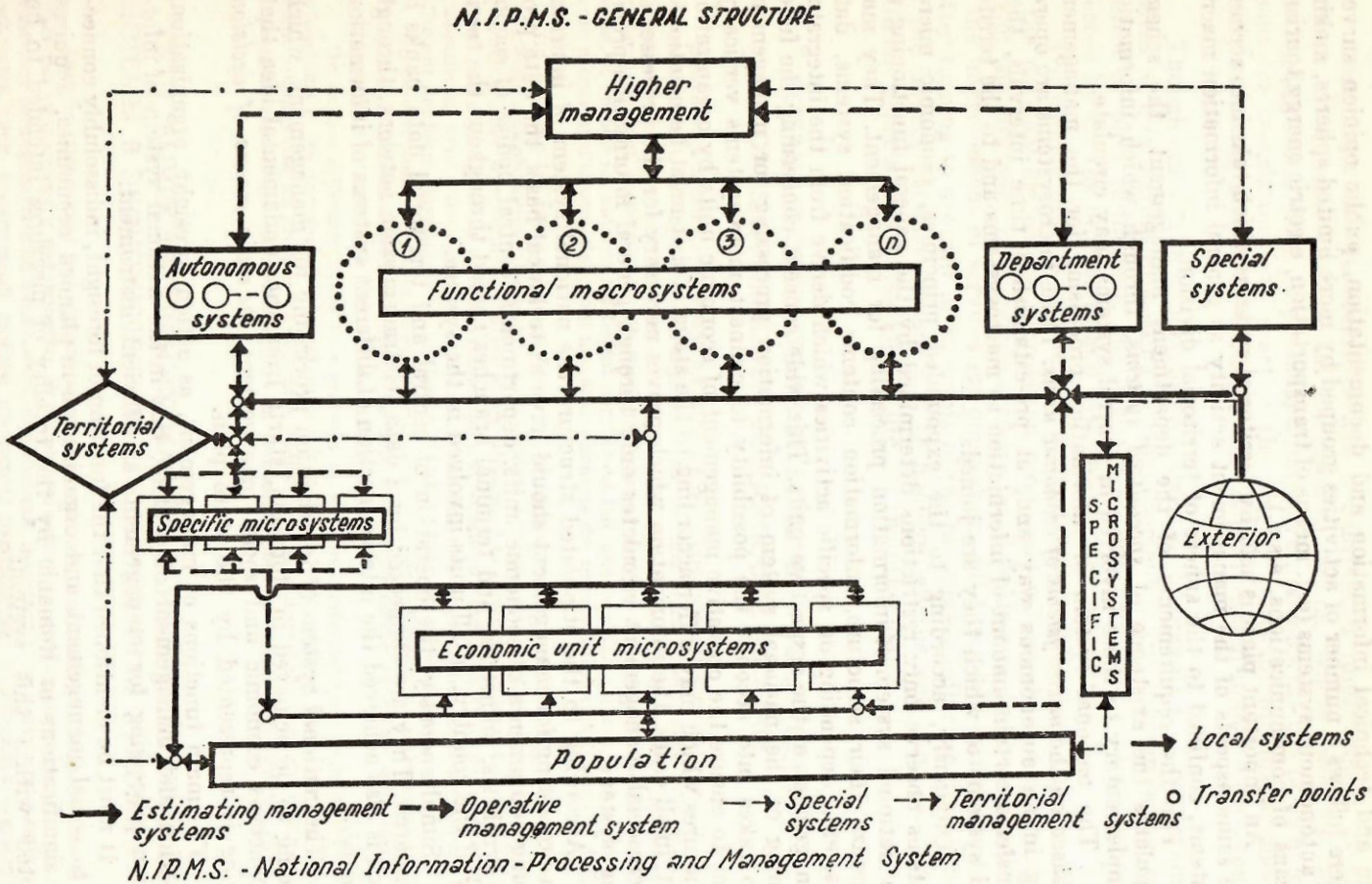
N.I.P.M.S. - GENERAL STRUCTURE
Higher management
Autonomous systems
1
2
3
n
Functional macrosystems
Department systems
Special systems
Territorial systems
Specific microsystems
Economic unit microsystems
SPECIFIC MICROSYSTEMS
Exterior
Population
Local systems
Estimating management systems
Operative management system
Special systems
Territorial management systems
Transfer points
N.I.P.M.S. - National Information - Processing and Management System

Fig. 3

tific and technical information and documentation, public opinion survey. There follows a number of activities grouped by more limited spheres, making up autonomous systems (e.g. means of transportation, electric energy,tourism, means of communications, a.s.o.).

An important place is held by territorial systems which take into account the same aspects of the management activity as general information macrosystems, confined to the sphere of territorial division.

For the requirements of the department management, the scheme stipulates the existence of *specialized systems*, through which information complementary to those involved in general systems may circulate.

The national system of information processing for the management is based on the *microsystems of economic units*. These microsystems are operating in an autonomous way and, at pre-established time intervals, they transfer a certain amount of information to macrosystems and to the territorial systems to which they are joined.

Obviously, according to the expounded principles, economic microsystems observe only restrictions determined by the general functioning of the national system of information processing for management. They may organize their structure, information content, codification systems, data files, etc., depending on specific activities which derive from the integrated management of the respective units. This wide concept concerning the functioning of the national system of information processing for management also takes into account the possibility to connect microsystems vertically, so as to ensure the operative management of economic units by organization structures which may differ according to the stage. Yet it must be mentioned that, in all cases, the information which proves necessary for the processes of macrosocial management circulates only through general information-processing systems.

According to the stipulated structure the national system of information processing for management should have as technical basis, the data processing equipments of economic units, departments, central bodies of economic synthesis, ministries, and terminal branches spread throughout the territory of the country, in all units involved in the system.

Simultaneously, the operation of central and territorial data banks is stimulated. They are connected by a data teletransmission network, through which is also achieved the interconnection of different systems of information processing.

The national system of information processing for management, which is going to be achieved in Romania, starts from the fundamental idea that as concerns economic and social management, *the main means of decision making* is represented by the state plan.

The main functions of management, as action foresight, organization, initiation and management or control, find in the national system of information processing for management, an efficient instrument.

It must be mentioned that the function of foresight, indissolubly connected to social management and organization in planned economies, acquires new significations in Romania by the totality of measures intended to be adopted within this system.

Component macrosystems permit a substantial improvement of the content of economic and social development plans, whose working out, starting from enterprise proposals and initiatives, enables the use of technical means for translating into practice the idea of participating management, widely involving masses to establish the objectives and manage any economic activity.

Though one of the important objectives in the operation of the national system of information processing for management is the substantiation and control of plan fulfillment, the activity of information-processing systems exceeds by far the objectives and tasks of planned management.

We cannot draw a conclusion without emphasizing that the creation of the national system of information processing will result in a substantial use of the efficiency of economic activity in all fields and, at the same time, in the improvement of services for population. All these will contribute to a better turning to account in Romania of the favourable influence determined by the impact between science and technology, on the one hand, and the different aspects of social-economic life, on the other hand.

RESEAUX D'ORDINATEURS ET SYSTEMES INFORMATIQUES DANS LA DIRECTION ECONOMIQUE ET SOCIALE

Les auteurs dédient cette étude à l'influence que l'informatique exerce sur les structures et le management. L'activité de management est, de nos jours, directement influencée par les transformations qui ont lieu dans la science et la technologie. On a mis en relief le cycle parcouru par tout processus de direction, information-analyse-variantes-décision-action-information, et ensuite les auteurs, en tenant compte du fait que ce cycle commence et se termine par un processus d'information, font une ample analyse des processus informationnels et de l'informatique.

On présente les rapports où se trouvent les processus informationnels traditionnels et les systèmes informatiques cybernétiques, de manière à assurer une réaction inverse (feed-back) permanente entre le système d'analyse et de décision. Les auteurs envisagent, pour l'avenir, l'association de la notion de direction économique et sociale au concept de système informatique, en aboutissant ainsi à des systèmes aux niveaux des micro et macrostructures économiques, qui utiliseront toujours davantage les méthodes et les techniques cybernétiques.

On prévoit pour les techniques et les méthodes actuellement créées un relèvement évident pu niveau d'optimisation qui sera utilisé à l'échelle macroéconomique, problème qui constituera une préoccupation centrale de l'activité de management.

On expose différents types et structures de systèmes informatiques pour la direction, les fonctions et les principes de réalisation de ces systèmes et les réseaux d'ordinateurs, en énumérant et analysant les groupes de systèmes d'informatique utilisés dans l'activité de direction. On présente ensuite les mesures adoptées en Roumanie pour la création du système (STAD).

СЕТИ ВЫЧИСЛИТЕЛЬНЫХ МАШИН И ИНФОРМАТИЧЕСКИЕ СИСТЕМЫ В ЭКОНОМИЧЕСКОМ И СОЦИАЛЬНОМ РУКОВОДСТВЕ

Авторы посвящают эту статью вопросам влияния, оказываемого информатикой на структуры управления и руководство. В настоящее время на деятельность по руководству оказывают непосредственное влияние преобразования, происходящие в науке и технологии. Выявляется цикл, проходимый любым процессом руководства: информация — анализ —

варианты — решение — действие — информация, а затем, учитывая, что этот цикла начинается и заканчивается информационным процессом, авторы производят широкий анализ информационных и информатических процессов.

Указываются соотношения, в которых находятся традиционные информационные системы и кибернетические системы информатики таким образом, чтобы обеспечивать постоянную обратную связь (feed-back) между подлежащей управлению экономической системой и системой анализа и решения. Авторы предвидят на будущее сочетание понятия экономического и социального руководства с понятием системы информатики, что приведет к системам на уровне экономических микро- и макроструктур, которые будут все больше применять кибернетические методы и технику.

В результате созданных в настоящее время методов и техники предвидится явное повышение уровня оптимизации, которая будет применяться в макроэкономическом масштабе, причем этот вопрос будет являться центральным предметом деятельности по управлению.

Приводятся типы и структуры информатических систем для руководства, функции и принципы осуществления этих систем и сетей вычислительных машин, причем перечисляются и рассматриваются группы систем информатики, применяемых в деятельности по руководству. Затем указываются проведенные в нашей стране мероприятия по созданию системы (S.P.I.D.).