

JPRS 71942

27 September 1978

20000503 050

TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY  
PHYSICAL SCIENCES AND TECHNOLOGY

No. 51

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<b>BIBLIOGRAPHIC DATA SHEET</b>	1. Report No. JPRS 71942	2.	3. Recipient's Accession No.
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4. Title and Subtitle TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY - PHYSICAL SCIENCES AND TECHNOLOGY No. 51	5. Report Date 27 September 1978
	6.

7. Author(s)	8. Performing Organization Rept. No.
--------------	--------------------------------------

9. Performing Organization Name and Address Joint Publications Research Service 1000 North Glebe Road Arlington, Virginia 22201	10. Project/Task/Work Unit No.
	11. Contract/Grant No.

12. Sponsoring Organization Name and Address  As above	13. Type of Report & Period Covered
	14.

15. Supplementary Notes

16. Abstracts

The report contains information on aeronautics; astronomy and astrophysics; atmospheric sciences; chemistry; earth sciences and oceanography; electronics and electrical engineering; energy conversion; materials; mathematical sciences; cybernetics, computers; mechanical, industrial, civil, and marine engineering; methods and equipment; missile technology; navigation, communications, detection, and countermeasures, nuclear science and technology; ordnance; physics; propulsion and fuels; space technology; and scientists and scientific organization in the physical sciences.

17. Key Words and Document Analysis.			17a. Descriptors		
USSR	Electronics	Missile Technology			
Aeronautics	Electrical Engineering	Navigation and			
Astronomy	Energy Conversion	Communications			
Astrophysics	Materials	Detection and			
Atmospheric Sciences	Mathematics	Countermeasures			
Chemistry	Mechanical Engineering	Nuclear Science and			
Computers	Civil Engineering	Technology			
Cybernetics	Industrial Engineering	Ordnance			
Earth Sciences	Marine Engineering	Physics			
Oceanography	Methods	Propulsion and Fuels			
17b. Identifiers/Open-Ended Terms	Equipment	Space Technology			

17c. COSATI Field/Group 01,03,04,07,08,09,10,11,12,13,14,16,17,18,19,20,21,22

18. Availability Statement Unlimited Availability Sold by NTIS Springfield, Virginia 22151	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 52
	20. Security Class (This Page) UNCLASSIFIED	22. Price PC A02

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PROSPECTS FOR CREATION OF A NATIONAL AUTOMATED TRANSPORT CONTROL SYSTEM

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 3, May/June 78 pp 3-5

[Article by A. P. Petrov]

[Text] Transportation is one of the most complicated areas of material production. The following types of transportation are distinguished: main line transportation (railroad transportation, marine, air, motor transportation, river transportation and pipelines) controlled by five union and more than 30 republic ministries; industrial transportation controlled by a large number of organizations of the various ministries and departments; municipal transportation, departmental transportation (basically motor transportation).

Territorially, transportation is distributed like no other branch of the national economy. It includes 138,000 km of main line railroad track, 88,000 km of railroads at the industrial enterprises, 1.4 million km of roads and highways, 156,000 km of oil and gas lines, 145,000 km of inland waterways and 827,000 km of regularly operating airlines.

The freight turnover of all forms of transportation in 1975 was 5.5 trillion ton-kilometers, and the passenger turnover was about 750 million passenger-kilometers. These material flows are reflected by the information flows which amount to several billion bytes per day.

Transportation is directly connected with the production processes of all branches of the national economy. All of the deviations and the functioning of the national economy influence it: **time of year** meteorological conditions, and so on. All of this increases the requirements on the control of transportation, and under modern conditions it leads to the special necessity for the introduction of automated control systems for types of transportation and transportation as a whole.

The branch automated control system of each type of transportation is constructed by the hierarchical principle, having, as a rule, a three-level structure: the upper level (ministry), the middle level (railroads, steamship lines, territorial administration) and lower level (the railroad junction, port, the combined aviation group, repair plant, motor vehicle enterprise, and so on).

The functional subsystems of the branch automated control systems are similar to a significant degree (although their names differ somewhat):

- a. control of the hauling process (operative planning and regulation of hauling, technical and technological standardization, monitoring of the use of the transport fleet);
- b. long-range forecasting and planning of operations and the development of transportation;
- c. control of the basic production transport enterprises--stations, ports, and so on;
- d. control of the enterprises performing current maintenance and repair of the transport equipment;
- e. the reservation of seats on trains and aircraft and arranging trips;
- f. statistical and bookkeeping accounting, the control of material and technical supply, financial activity, personnel, and so on.

Fifteen to 20 subsystems are provided in each branch automated control system. The first phases of the automated systems for main line forms of transportation were put into operation in the Ninth Five-Year Plan. However, the work in the different forms of transportation is being done without proper correlation among them and the higher-level control systems. The All-Union Automated System (OGAS) must include the automated control systems for types of transportation not separately but as an integral coordinated complex.

It is possible to consider the following among the most significant deficiencies arising from the departmental separateness, which lower the effectiveness of introducing the automated control systems in transportation.

The problems of the complex development and utilization of transportation, especially the optimal distribution and operative redistribution of hauling among the types of transportation during the year, during the periods of individual seasons (planting, harvesting, other special situations), the problems of the operating efficiency indices compared for the types of transportation, analysis of mixed hauling, the organization of hauling and information about it at the transport junctions, organization of containerized hauling with the participation of two or more types of transportation, and so on are not in general considered in the automated control systems.

The information and technical base of the branch automated control systems is varied. There is no general primary data coding system, and up to now even the many times investigated united classification of freight has not been adopted. The types of computers are not compatible programwise, and their composition differs; the industrially produced computers do not satisfy the demands of transportation with respect to efficiency and reliability.

The exchange of experience between the automated control systems for the various types of transportation (procedures, technical assignments, programs, experience in the operation of the equipment, and so on) is realized irregularly, by individual problems or in conferences, and there are very few joint developments.

The solution of the enumerated problems must be promoted by the newly organized Council of Principal Designers of Automated Control Systems for Types of Transportation. Obviously, for the control of the group of branch types of transportation a state control agency will be created. Thus, the national automated transportation control system (ASUT) will find its users and customers on this highest level. The state agency will not be a general ministry of transportation; therefore the role of the transport ministries and their responsibility for the coordinated operation will be improved.

The functions of the state general transportation agency could become:

- a. the development and implementation of a united economic and technical policy for transportation: determination of the proportions and the scales of development of the traditional and new types of transportation; determination of the matched types and parameters of the transport means, including the mechanization and automation means; the development of the systems for the direction of containerized hauling and the transport-expeditionary business, and so on;
- b. in the field of the future and annual planning of operations and development of transportation, the investigation of the demands defined by the Gosplan for shipping and the resources for the most proper establishment of the basic areas of coordinated development of a united national transport system, the distribution of shipping among the types of transportation, capital investments in material resources; the implementation of a tariff policy, which stimulates effective use of the transport network, the development of general transportation (compatible for the types of transportation) indices;
- c. in the operative control area, the development and introduction of an efficient shipping process in mixed communications, matching of the traffic schedules at the transport junctions; the preparation and direction of the execution of the operations connected with mass shipping (harvesting, export-import hauling, and so on); the preparation of the normative and legal documents with the participation of the transport ministries;
- d. the monitoring of the efficiency of the operations at the most important transport junctions.

In order to implement the functions of the national general transport agency it is necessary to create, introduce and provide for the operation and maintenance of the ASUT as a coordinated set of automated control systems for types of transportation supplemented by the new highest control agency. It

is also necessary to create subsystems in this complex for the control of large transport junctions. The technical base must include the main computation center for the ASUT as a component part of the OGAS, the network of the collective-use computer centers for the automated control systems for transport junctions and the data transmission networks.

In order to ensure unity of the economic and technical policy and improve the coordination of operations, it is now necessary to organize a union-republic ministry of motor transportation, construction and maintenance of highways and a union ministry of river transportation.

It is necessary to improve the internal administrative structure of each type of transportation, considering primarily a reduction in the number of hierarchical links and concentration of control following from the possibilities of modern means of data transmission and data processing on computers. It is expedient to develop general, interconnected control systems for types of transportation, investigating the effect of the technical progress on the composition and content of the control functions, the distribution of the functions and the authority between the control levels, the dimensions of the primary element in the branch control system, the interrelation of the territorial and branch agencies, and so on. A united service must be organized in each type of transportation for the processing of all types of information. This service should have a network of interconnected computer centers and supply all other services with the necessary data and documents for control.

The target program of scientific research work for the 10th Five-Year Plan approved by the State Committee of the Council of Ministers of the USSR on Science and Technology includes for the first time the problem of scientific and procedural principles of the ASUT. It is expedient to state two primary specific goals of the research:

- 1) the preparation of the technical assignment for the ASUT;
- 2) the development of the basic principles of the master plan for the staged development of the ASUT to the year 1990.

The operations must include the following:

- a. analysis of existing structures of transport control and the types of transportation;
- b. determination of the functions and specific problems solved using the ASUT for the new national general transportation agency connected with the goals of the automated control system for the types of transportation and establishment of information flows with respect to the 5-year stages of development;

c. the overall functional, structural, technical and organizational construction of the ASUT agencies--computer centers and data transmission networks--coordinated with the OGAS; here primary attention must be given to the organizational base of the transport junctions and the role of the highest-level computer center;

d. selection of the optimality criteria for the solution of the general transport problems;

e. development of the information support, including the primary data coding system which is common to all types of transportation, classifiers and standardized forms of documentation, the method of forming the data banks for operation in the system mode;

f. selection or development of standard mathematical and program support; the creation of a general library of procedures and programs for the solution of the standard general systems of problems of the automated transport control systems and also the problems which repeat in each type of transportation: the long-range planning, operative-statistical and bookkeeping accounting, calculation of wages, shipping documents, and so on;

g. the development of standard transport requirements for the compatible technical means of gathering, transmitting, storing and processing the data and outputting the results and also the representation means; the selection of standard means based on the integrated system of computers, outfitting them and providing for redundancy;

h. assurance of interaction of the transport system of the USSR with the transport systems of the CEMA member-countries;

i. the stepped nature of the introduction of the ASUT;

j. the organization of the design and introduction of the ASUT (users, times, material support, technical-economic effectiveness).

The technical assignment and basic principles of the master plan for development of the ASUT obviously must include the general systems part and also the principles developing and supplementing it with respect to each type of transportation.

One of the most complex problems is an organizational aspect of control of the transport units where railroad, marine, river and motor types of transportation participate. There is positive work experience in the Leningrad and Odessa transport units approved by the Central Committee of the CPSU, but it is necessary to define the standard organizational base here.

Whereas the creation of a united collective-use network computer center does not encounter theoretical difficulties in technical respects, its administrative subordination, for example, to the controlling agency of one type of

transportation or the use of the OGAS collective-use computer center located in the network or any other solution requires preliminary careful study of all possible versions.

The program of operations planned above cannot be carried out only on social principles. In addition to the interested state general transportation agency it is necessary that a competent, quite powerful scientific research and planning and design organization be allocated as the main organization for the development of general procedural, tactical, organizational and other problems of creating the ASUT. The work must be performed by the coordination plan with the participation of the VNIIPDU, the branch scientific research institutes and design organizations for the forms of transportation, the Ministry of Instrumentmaking and the Ministry of the Radio Industry. Experience in such collective developments is available. For example, the Institute for Complex Transport Problems under the USSR Gosplan has begun the development of the transport system of the Gosplan ASPR [automatic system of planning estimates]; under the direction of the section on the complex problem of the control of transport processes (at present part of the Scientific Council on Computer Engineering and Control Systems of the GKNT and the Presidium of the USSR Academy of Sciences), the specialists of all forms of main transportation have prepared predictions for the development of automated control systems to 1990 with separation of the next 5-year period. However, the creation of the ASUT is a much larger-scale problem, and special attention must be given to the organization of its resolution.

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10845  
CSO: 1870

UDC (62-52:681.3.06.2):656.2./43

AUTOMATED CONTROL SYSTEMS IN RAILROAD TRANSPORTATION AND FURTHER DEVELOPMENT OF OPERATIONS WITH RESPECT TO IMPLEMENTING COMPLEX AUTOMATED RAILROAD TRANSPORTATION CONTROL SYSTEM

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 3, May/Jun 78 pp 110-112

[Article by K. V. Kulayev; submitted 22 March 1977]

[Text] During the Ninth Five-Year Plan subdivisions for the introduction of computer engineering and the creation of automated control systems were organized on all the railroads of the country. They provide for the development and introduction of standard effective mass calculations on computers permitting optimization of a number of the processes of the average daily and operative planning and also the processing of primary documents for the analysis of the use of technical means. The scientific development of the complex automated control system for railroad transportation (ASUZhT) has been carried out on all levels of management with forecasting to 1990, and the transition from the independent solution of the problems on a computer to their integration in systems operation with the communication channels has started.

Tens of medium-power computers and hundreds of data reception and transmission stations to the computer centers equipped with telegraph have been put into operation. The number of solved problems has increased tenfold. The cost benefit has risen by more than five times. The standardization of the hardware, software and information support of the primary problems has made it possible to increase the work volume by 8.5 times with a total growth of number of computer center workers of 2.3 times.

The most significant problems have been solved in the technical and technological normalization of the shipping process and operative control of the operation of the shunting yards. On all of the railroads the monthly shipping plans are compiled by machine methods with discovery of the inefficient correspondence not corresponding to the layouts of the normal freight flow routes. The shipping plans serve as the base for the development of the technical operating norms on the computer. The procedure for calculating the network plan for the formation of freight trains on a computer permits

investigation of the car flows immediately between 170 basic shunting yards of the network. The performance of the traction calculations on a computer offers the possibility of obtaining more exact results with no expenditure of labor and improvement of the train-handling conditions. Projects have been started for machine compilation of the train traffic schedule.

An operative system is being created for the forecasting and planning of operations on the level of station, road and road division administration. At the present time more than 50 large shunting yards in the network are receiving work plans for the next 3-6 hours calculated by the road computer centers. At some stations automated control systems have been set up which realize the operative planning and compilation of documents for the formed trains by computers installed directly at these stations. The base for the calculation is the telegram data in the form of schedules showing the composition and freight details of the trains.

The information computer center of the Ministry of Railways predicts the car flows a week ahead. The calculations are performed annually for the next 7 days.

The operations at the commercial accounting offices where the cashier and finance accounting and bank documents for shipping the freight are compiled on a centralized basis have been automated on all of the railroads. The Gor'kiy, Southern Ural, Kuybyshev and Sverdlovsk railroads have introduced and successfully carry out integrated processing of the mass document in the form of the engineer's sheet.

A system has been organized for computer tracing of the refrigerated rolling stock, the heavy freight containers, and so on.

The solution to these problems, the centralization of the processing of the schedules and the shipping documents at the railroad computer centers and also the use of the equipment connected to the Minsk-1560 communication channels is an important step on the path of the creation of the dynamic model of the shipping process on the railroad level. This model will permit more substantiated and operative planning and regulation of shipping and tracing of the movement of any unit of rolling stock (and subsequently, dispatching of it) without resorting each time to the development of special software.

Within the Ministry of Railways and on the railroads work is being done to create an information-reference system designed for equipment of the managers with carefully selected and classified information. On a number of railroads this system based on the operative accounting data is already functioning.

The "Express" system for reserving places on the long-distance passenger trains and selling tickets which can handle the sales of more than 130,000 tickets a day has been put into industrial operation on the Moscow network.

The development and subsequent introduction of the first phase of the automated railroad transportation control system have taken place with respect to functional subsystems for all levels of administration, but the thrust has been in the basic, middle link--the railroad with its computer center capable of both solving problems for the subdivision and supplying the required information to the ministry.

In the 10th Five-Year Plan the Ministry of Railways has set up operations with respect to the creation and introduction of a second phase of the automated railroad transportation control system. This will not be a simple expansion of the functions of the already existing automated control systems. It will complete the preparations for conversion to a new qualitative level based on the third-generation computers and standard systems solutions. It is possible to isolate some basic areas in this work:

- a. integration of the processing of the basic primary information and organization of data banks;
- b. the creation of information-reference systems on the levels of direction of the Ministry of Railways and railroads with representation of the machine responses on the displays for taking operative regulatory measures;
- c. the development and introduction of standard design solutions for the second phase of the automated railroad transportation control system for the levels of the ministries, railroads and shunting yards.

During the 10th Five-Year Plan gradual reequipment of all of the computer centers, equipment of them with two or three computers of the integrated computer system and modern data transmission means have been provided for. This permits implementation of the experience in the integrated data processing accumulated by a number of the computer centers of the railroads on broad scales, and it makes it possible to create a data bank with simulation of the hauling process.

The concentration of information on loading and unloading, the operating fleets and other data in the railroad computer centers permits implementation of a dialog information-reference system for monitoring the operative work of the railroad and provision of the same system of the Ministry of Railways with the required data. The information-reference systems will store large volumes of information on freight and train operation, car and locomotive fleets and other data for comparison with the norms.

A second phase of the subsystems for "normalization of the shipping process" and "operative control of the shipping process" is to be introduced on the level of the Ministry of Railways in 1978-1980. In addition, the development and introduction of the remaining subsystems of the automated railroad transportation control system, including the ASPR [automatic system of planning estimates] coordinated with the corresponding system of the USSR Gosplan, will be expanded.

A large amount of work is to be done with respect to the creation of the automated control systems at the shunting yards and junctions. Whereas operative planning of their work is being successfully carried out by the railroad computer centers, it is expedient to leave the direct control of the execution to the yard (or junction) computer. The automated control systems at the shunting yards are in the automated technological process control system category. Together, they make up an interconnected network of automated stations which, for example, transmit specific information from computer to computer.

The automated control systems at the shunting yards must be considered as the first step in the creation of the lower-level automated railroad transportation control systems--the junction computer centers. Therefore, both the hardware and the selection of the yards themselves for implementing the automatic control systems must be arranged so that they correspond to the planned location of the future network computer centers and can form part of them.

The calculations performed at the Central Scientific Research Institute of the Ministry of Railways for a number of specific railroads demonstrated that the optimal number of junction computer centers on the network is much less than the existing number of divisions, that is, the junction computer center must be created for servicing of two or three divisions (the basic one with a large junction and one or two with smaller volumes of work) having quite close economic and technological ties.

In order to improve the servicing of passengers and for automation of accounting with respect to the passenger hauling, provision has been made for the creation of reservations centers which are connected to each other on the basis of the standard designs (the "Express-2" system) in Moscow, Leningrad and Kiev. Each center will be designed for several hundreds of serviced trains with ticket sales for all stations of the railroad network. The output capacity of the center must be increased by several times by comparison with the system operating in Moscow. The reservation time has been significantly increased. The number of ticket offices and information units must allow the passenger to obtain a ticket with minimum expenditure of time.

Finally, there has been significant development of the two-element "main administration-plants" subsystem of the automated railroad transportation control system constructed as a type of industrial ministry and providing for the repair of rolling stock and the production of spare parts.

The qualitatively new level of development of the automated railroad transportation control system in the 10th Five-Year Plan is based on the quite broad possibilities of the third-generation computers. The program compatibility of the various computers of the integrated system of computers and the presence of a developed operation system are greatly facilitating the programming and application of high-level algorithmic languages. The

OSYeS-4.0 has been selected as the operation system for the automated railroad transportation control system (on the basis of the comparison of various possibilities). It is necessary to adhere strictly to this united system for all developments in order that the prepared programs be of an organized nature and be a part of the general systems software. In order to solve the problems connected with the creation of software, a group of specialists has been organized in the Ministry of Railways.

In the 10th Five-Year Plan, a characteristic feature of the hardware is that along with the third-generation computers, the Minsk-32 and the Ural-14D computers now available on the railroads will also be used. They can be fully operated for several years on mass calculations. However, for the large automated control systems for railroads operating in the mode of direct communications of the subscribers with the computers, quite powerful computer complexes are required. Calculations show that for the accomplishment of all of these goals in the second phase the railroad computer center must be equipped with three or four computers with a speed of 200,000 to 500,000 operations with a ready-access memory of no less than 512K bytes. On the lower level of the automated railroad transportation control system, the standard automated control systems at the shunting yards are being equipped with the YeS-1010 computers which have lower output capacity than indicated above. Therefore the computer complex of the junction computer center obviously must be made up of no less than two YeS-1022 or YeS-1033 computers and two or more computers controlling (in the future) the execution processes at the junction and in the sections.

For the "Express-2" system it is proposed that a computer complex be built which is based on the high-output computers of the integrated system, the production of which is planned for the second half of the 10th Five-Year Plan.

In the near future the railroads will continue to be equipped with telegraph units. They will simultaneously begin to receive the subscriber stations of the integrated system and the data transmission multiplexers, on the basis of which the creation of an integrated data transmission network with message commutation (instead of channel commutation) will be started. Here, in the future the subscriber stations can be connected to the concentrators which, in turn, will be connected to the message commutator--the specialized computer performing a logical check on the message, automation of operations, and so on.

The automated readout of the information from the moving rolling stock which is to be started in the next, 11th Five-Year Plan, has great significance for the realization of a detailed dynamic model of the hauling process and for control in real time.

The problems of the realization of the automated railroad transportation control system in the next 5-year plan are only an intermediate phase. This phase cannot be considered separately from the subsequent operations. The

development of the basic principles of the master plan for development of the automated railroad transportation control system to the year 1990 has been completed at the Central Scientific Research Institute of the Ministry of Railways. The automated railroad transportation control system must in the next 15 years provide for optimal control of the operation and maintenance of the railroads and, above all, the hauling process. The long-range plans for the development of railroad transportation must be optimized, and an optimal ratio must be achieved between the carrying capacity and the fleets of rolling stock. It is necessary to provide for operative planning and control on all levels of administration, modern correction of the normative documents and more flexible application of the regulatory measures.

Computer engineering can give the greatest effect only in the case of proper correspondence of it to the possibilities of the organizational forms of administration. Concentrating the data processing, it also promotes the centralization of control. Hereafter, the functional services of administration must be freed to the maximum from the accounting work, including the optimization calculations. All of this must be provided for by the integrated information system which will function on all control levels on the basis of modern computers.

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10845  
CSO: 1870

UDC (62-52:681.3.06.44):(656.2./43+658.75.2)

EXPERIENCE IN CREATION OF AN AUTOMATED CONTROL SYSTEM FOR GENERAL-PURPOSE  
MOTOR TRANSPORTATION IN RSFSR AND PROSPECTS FOR ITS DEVELOPMENT

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 3, May/June 78 pp 116-118

[Article by N. S. Korolev; submitted 31 December 1976, revised 20 February 1978]

[Text] The workers in general-purpose motor transportation are among the workers who occupy an uncompromising position in the problem of the necessity for comprehensive introduction of computers in motor transportation administration. This is dictated by the fact that motor transportation, which is one of the youngest forms of transportation and does not have such a rich portfolio of scientific research in the field of administration and control as the railroad, marine and river transportation, will acquire a powerful tool in the automated control system which will in the near future provide for a sharp increase in the efficiency of use of the rolling stock and improvement of the quality of the servicing of the national economy.

The necessity for the acceleration of the introduction of the automated control system in motor transportation is also dictated by the fact that with respect to its structure, nature and the specifics of implementing the hauling process this form of transportation appears complicated and most difficult to control. Motor transportation as a system is made up of a large number of territorially scattered economic subdivisions and an enormous number of autonomous mobile units. In the Ministry of Motor Transportation of the RSFSR alone up to 320,000 different motor vehicles and motor vehicle trains participate simultaneously in the transport process.

Motor transportation has become a connecting link between the customer and other forms of transportation, between all types of transportation--their initial and final phases. The direct contacts of this type of transportation with the customer are superior to the contacts of any other type of transportation. All of this generates additional difficulties in the control of motor transportation, it leads to significant losses of shipping possibilities, and it increases the transport expenditures.

This is explained to a great extent by the fact that motor transportation is the most labor-consuming and money-consuming form of transportation. According to the calculations of the specialists at the NKTP [People's Commissariat of Trade and Industry] under USSR Gosplan, out of the 70 billion rubles of total expenditures on all forms of transportation, the greater half goes to motor transportation. Out of the 13 million people working in all forms of transportation, almost two-thirds are connected with motor vehicle hauling and shipping.

During the period from 1950 to 1977 the number of workers in general-purpose motor transportation increased by more than 20 times. Each percentage increase in number yielded a 3-percent increase in volume of transport operations at the same time as on the railroads a 1-percent increase in number brought a 20-percent increase in transport operations, in marine transportation, about 7 percent, and in river transportation, 8.5 percent.

In spite of the constant growth of the demand of the national economy for motor vehicle hauling and shipping, a further increase in this type of shipping with such demands on the manpower reserves will become a burden to the national economy.

In the plans for the national economy in the 10th Five-Year Plan and subsequent years provisions have been made to take steps toward the production of high-capacity trucks, the manufacture of loaders, improvement of the highway network, which will lead to significant reduction of the labor consumption and the financial drain of motor transportation. However, the growth rates of the demand of the national economy for motor transportation are exceeding the existing growth rates of its possibilities and are forcing the motor transportation specialists to find means of comprehensive mobilization of the available reserves and to discover and eliminate deficiencies.

This problem can be solved to a significant degree and in the shortest possible time by the broad application of mathematical-economic methods and computers based on the introduction of automated control systems on all levels. This is not only a matter of the fact that with the introduction of automated control systems the administration of the ministry is being equipped with decisionmaking methods and means which should raise the level of administration and improve the efficiency of the use of the transport means, but also, in developing and introducing this system, it is necessary to criticize the existing imperfect procedures and establish new ones corresponding to the modern increased requirements.

During the Ninth Five-Year Plan the freight turnover throughout the Ministry of Motor Transportation of the RSFSR has increased by 1.5 times, and passenger turnover by 1.6 times. The passenger hauling in taxis has been increased by 1.9 times. More than 70 percent of the increase in freight turnover, about 40 percent of the increase in passenger turnover and 30 percent of the increase in taxi hauling have been obtained as a result of improvement of the technical-operating indices of the use of the rolling stock; about 75

percent of the increase in transport operations has been realized as a result of increased productivity of labor. A defined portion of this increase has been obtained as a result of increased intensity of the use of transport means which has been achieved as a result of using a computer, the introduction of automated control systems and process communications means.

In the Ninth Five-Year Plan 20 automated control systems were created in the ministry, including the first phase of the automated control system for the upper level of administration, 6 automated control systems for territorial transport administrations, 7 automatic repair enterprises, and so on. These automated control systems provide for the gathering and processing of data, they solve more than 100 sets of problems in the field of future and current planning, operative regulation of the transport process, material and technical supply, capital construction, labor and wages.

The Scientific Research Institute of Motor Transportation, the Main Computer Center, the ASU-proyekt Automated Control System Special Design Office and individual computer centers are working on the development of the automated control systems in the ministry. The development of automated control systems is also attracting a number of design organizations of other ministries and departments. For coordination of the work of creating the motor transportation automated control systems, for improvement of the control system, formation of the network of computer centers in the ministry, a specialized subdivision has been created--the Main Automated Control System for Motor Transportation.

The technical base of the branch automated control system includes 28 group computer centers equipped with like computers, which has promoted the assurance of software and hardware compatibility of the created automated control systems.

Nine general systems classifiers of technical-economic information used to solve problems on the level of the transport administrations and the ministry (the classifier of enterprises, organizations and institutions of the Ministry of Motor Transportation of the RSFSR, including more than 3,000 positions; the classifier of customer enterprises with up to 3,000 positions, and so on) have been created in the branch. Work is being done on the introduction of the all-union classifiers, the creation of standardized document systems for motor transportation ensuring information coordination with the Rossiya [Russia] automated control system.

The problem of designing automated control systems is facilitated significantly by the creation of standard design solutions. The use of prepared statements, algorithms, the standard information support, the hardware complex, organizational and economic support reduces the cost of developments by 40-60 percent.

The introduction of the first phase of the branch automated control system and the series of transport administration automated control systems into

operation has made it possible to perform many labor-consuming calculations at the computer centers. The plans for material and technical support and capital construction with respect to the ministry as a whole and the transport administrations have begun to be calculated on computers. In the group computer centers and the machine accounting stations, 51 million trip logs (35 percent) and 70 million commercial transport overhead statements (22 percent) are processed annually. A significant role in automated control systems has been given to the performance of the accounting and analytical work, the proportion of which is about 50 percent of the total volume of the problems solved in the computer center. In the branch automated control system, a number of problems of the summary bookkeeping budget with respect to the ministry have been resolved, and a united form of financial-economic analysis of the activity of the ministry and its subdivisions has been introduced.

The problem of the automation of the control of the operation and maintenance of the city bus transportation plays a special role in the development of the automated control system for motor transportation on different levels. At the present time the automated dispatch control system for bus traffic (ASDU-A) is in industrial operation in the city of Omsk. In ensuring operative monitoring and control of the city bus traffic in real time, this system improves the regularity of the bus movement, efficiently distributes the buses along the routes, and creates conditions for significant improvement of the efficiency of utilization of the rolling stock and quality of servicing the passengers, increasing the hauling volume by 8-10 percent in so doing.

The total savings from the automated control system and solution of the problems of improving the transport process during the Ninth Five-Year Plan amounted to more than 70 million rubles with expenditures on creation of them and the introduction of computer engineering in the amount of 77.5 million rubles.

During the years of working on improvement of the control system in the industry, a trend has been noted toward a reduction in the growth rate of the number of people involved in administration: the number of workers in the administrative apparatus per million in value of fixed productive capital has been reduced from 39 in 1970 to 21 in 1975, and the volume of transport work for one worker in the administrative apparatus has been increased by 49 percent.

In the 10th Five-Year Plan the volume of operations with respect to the introduction of computer engineering will increase throughout the ministry by almost three times by comparison with the Ninth Five-Year Plan, and the computing power of the installed computers will increase by approximately four-fold.

For the development of the technical base of the motor transportation automated control system, it is planned that 15 group computer centers will be

built, and the computing capacity, of the existing ones will be expanded, bringing the total speed of the computer to 6.3 million operations per second.

The branch automated control system has received further improvement as a result of expansion of the packages of problems with respect to 13 functional subsystems and as a result of a significant increase in the proportion of the optimization problems. A great deal of attention will be given to increasing the volumes of complex processing of trip documents and statistical accounting.

The problem of the training of the specialists with respect to the operation and maintenance of computer equipment and communications means, the specialists with respect to mathematical-economic methods and motor transportation automated control systems and also the personnel managers continue to remain an urgent problem. In 1972-1977 112 managers in the central administrative apparatus of the ministry and republic associations went through the courses for advanced training of personnel managers in accordance with a special program; however, the interests of the matter require broader education of the engineering and technical workers in the new forms of production control.

By the end of the 10th Five-Year Plan the motor transport automated control system will be created in the Ministry of Motor Transportation of the RSFSR, including all levels of administration: the automated control system for the ministry, the automated control system for the large transport administrations, the automated production control systems for the motor vehicle repair plants and production associations. These systems will encompass about 50 percent of the volume of shipping and hauling and 25 percent of the volume of automotive repair work performed by the ministry.

The experience in working on the development and introduction of automated systems in the general-purpose motor transportation will permit some generalizations to be made.

Above all, it must be stated that even in the presence of the standard technical assignment approved by the State Committee of the USSR Council of Ministers for Science and Technology for the branch automated control system, there was no unity in the approach to the development of the information software or to the selection of the hardware for the automated control systems in the motor transportation ministries of the union republics. This has frequently led to duplication and parallelism in the work and, as a consequence, to additional expenditures on the planning and design and the introduction of the automated control systems for general-purpose motor transportation in the country. A situation of software and hardware incompatibility of the designed systems has been created. At the present time measures are being taken to coordinate the work in the field of the development of automated control systems, but analysis of the materials from the studies which have been performed during the period of planning and designing automated control systems in the motor transportation ministries, the work

practice with respect to the introduction and utilization of the automated control systems confirm the national economic expediency and necessity for a union agency with respect to the control of general-purpose motor transportation.

It is impossible also not to note that on the path of active introduction of the automated dispatch control system in motor transportation for buses and taxis which is raising the transport process directly to a higher level, the support of the transport administrations with peripheral equipment, especially mobile units, has become extremely unsatisfactory.

On the path toward a greater utilization of the motor transport automated control systems and expansion of the volume of shipping planned on the computer, problems and difficulties are arising in connection with lack of correspondence of the interests or absence of equal interest of all segments of the transport process: the motor vehicle enterprise, the driver and the customer. It is necessary to develop an economic mechanism which will permit elimination of this contradiction.

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CSO: 1870

UDC (62-52:681.3.06.44):(656.2./43+658.75.2)

CREATION OF A GENERAL-PURPOSE MOTOR TRANSPORTATION AUTOMATED CONTROL SYSTEM  
IN UKRAINIAN SSR

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 3, May/June 78 pp 118-120

[Article by I. A. Motin; submitted 24 March 1977]

[Text] By the plans for the development of the national economy of the Ukrainian SSR in the 10th Five-Year Plan the Ministry of Motor Transportation of the Ukrainian SSR provides for increasing the freight turnover by 29.4 percent, passenger turnover by 20.2 percent, the volume of industrial production by 26.8 percent and the volume of sales of domestic services to the population by 20.8 percent.

One of the basic means of solving these problems is improvement of the efficiency of the administration of motor transportation by the broad application of mathematical-economic methods and computers for the operative control and planning and also on the basis of introducing the automated enterprise, organization and technological process control systems on all levels of administration. The first successful work with respect to the application of computers for the control of motor transportation belongs to the beginning of the Eighth Five-Year Plan. Since that time a great deal of work has been done in the training of personnel, improvement of the organizational structure and the process of branch control. Basic prerequisites have been created for the broad introduction of computers into the practice of motor transportation control. By the end of the Ninth Five-Year Plan the volume of operations performed by computer more than tripled.

During 1971-1975 a significant volume of work with respect to the creation and introduction of elements of automated control systems was done at the Ministry of Motor Transportation of the Ukrainian SSR. A base was laid down for the branch network of computer centers which today is made up of eight group and one main information computer center which interact functionally with 21 machine accounting stations and offices realizing computerized data processing in the motor vehicle administrations and associations. The basic computer fleet is made up of 9 Minsk-22 and Minsk-32 computers, 2 computers from the integrated system series (YeS series), 5 M6000 computers and

also 13 M5000 computers. The total volume of capital investments in 1971-1975 amounted to 15.1 million rubles.

Although this technical base was insufficient to provide for the demands of the branch for computer capacity, it permitted sufficiently broad introduction of computer engineering and mathematical-economic methods for the organization and administration of motor transportation in the Ukraine. By the end of 1975 the startup complexes or the first phases of the five automated systems on different levels were put into operation. The branch automated control system and the automated control system for the Kiev Administration of Freight Motor Transportation were the pilot models. Within the framework of the automated control system provision is made for the solution of a number of problems of future and current planning; operative control of the hauling process; material and technical supply and also the calculations with respect to labor and wages. The basic volume of processing of trip documents has been mechanized and automated. This has made it possible to lower the indebtedness and strengthen the financial condition of the motor transport enterprises of the ministry.

The volume of freight hauling planned using the mathematical-economic methods and computers has increased by more than threefold during the 5-year period. According to the optimal plans calculated by computer the hauling of building materials, petroleum products and small lots of freight is being realized in the trade network of the cities of the republic.

Special significance is attached to the introduction of the problems of operative planning and control of the coordinated operation of motor transportation of the various departments in hauling grain, sugar beets and other agricultural products during the harvest season. According to the schedules calculated by computer, more than 60,000 motor vehicles of the various ministries and departments operate in the republic annually. As a result of their efficient utilization, savings of more than 1 million rubles per year have been achieved. A significant cost benefit has been obtained when solving problems of determining the transport resources required to provide for hauling agricultural freight, as a result of which 1,000 motor vehicles less have begun to operate in the Kiyevskaya Oblast for hauling the harvest since 1974, and their efficiency has increased by 38 percent.

The volume of interurban hauling of freight in the Ninth Five-Year Plan has increased by fourfold and has reached 26 million tons, including the fact that regular hauling by the schedules calculated on the computer has increased by 1.6 times.

The improvement of the control system, the application of new technology, optimization of planning using the mathematical-economic methods and computers have made it possible to increase the output per average motor vehicle ton on establishment during the 5-year period by 21 percent reckoned in tons and by 24.5 percent in ton-kilometers.

By the end of the 5-year period the basic types of statistical accounting began to be processed on the computer, and the introduction of the information-reference system of the branch automated control system into operation made it possible to provide for operative presentation of broad information of an accounting and analytical nature to the administrative apparatus of the ministry from the results of the operations of the motor transport administrations and enterprises. The problem of determining the optimal specialization of the motor vehicle repair enterprises was solved, and a system of planning calculations was developed for compiling the average on establishment and future plans for the development of the motor vehicle repair enterprises.

On the whole, the application of computer engineering, mathematical-economic methods and modern communications means has significantly helped to improve the control of general-purpose motor transportation, and it has permitted a significant improvement in the transport servicing of the national economy of the republic and the population. The cost benefit from introduction of the automated control systems alone was 5.9 million rubles in 1971-1975.

In the current 5-year period the Ukrainian SSR Ministry of Motor Transportation is faced with the problems of further improvement of the operation of the general-purpose motor transportation for purposes of most complete satisfaction of the demands of the national economy for shipping of freight and passengers. A decisive course is being realized toward ensurance of efficiency and quality of all of the economic activity of the ministry, the mobilization of branch reserves and improvement of the productivity of labor. The successful fulfillment of the stated goals will be determined to a significant degree by how broadly and effectively the computers and mathematical-economic methods are introduced into control practice on all levels: from the ministry to the motor transport enterprises. Accordingly, in 1976-1980 there is to be a significant increase in both the number of functioning systems and the degree of encompassing of the various types of production and technological processes by them. On the whole, for the creation and development of automated control systems by comparison with the last 5-year period, an increase in the work volume by two times and the number of systems created by 2.7 times has been proposed. The realization of this work program must be accompanied by a significant improvement in quality and the scientific-technical level of the created systems and their technical-economic effectiveness.

The complex plan for the development and introduction of an automated control system determining the basic areas of their development has been worked out for the branch. These areas are the following:

1. Completion of the work with respect to the first phase of the branch automated control system and its subsequent development presupposing significant expansion of the automated functions, conversion to a new technical base and introduction of the modern technology of data processing and the organization of the computation process based on a united branch data bank.

By 1980 about 80 sets of problems encompassing all the basis aspects of activity of the upper element of the branch control will be solved within the framework of the branch automated control system.

2. The introduction of automated control systems on the level of territorial (oblast) motor transportation administrations, the development of the already existing systems and creation of new ones. These systems are to improve the quality of control on the middle element level significantly, primarily as a result of automation of the control of resources and optimization of the planning of freight and passenger hauling. By the end of the current 5-year period the automated control systems will be functioning in 11 motor transportation administrations.

3. The creation and introduction of the automated production and technological process control systems. Basic attention will be given to the automated systems for dispatch control of passenger hauling (buses and taxis) which are considered as a component (and highly important) element in the realization of the general quality control system for transport servicing of the population. By 1980 these systems will be put into operation in Kiev, L'vov, Voroshilovgrad, Simferopol and Donetsk. In addition, three automated production and technological process control systems will be put into operation at the motor vehicle repair and tire repair enterprises of the ministry.

The work with respect to the creation of automated control systems is being done at the present time on the basis of strict and successive application of the following principles:

- a. the creation of automated control systems on the basis of the integrated data processing systems;
- b. ensurance of the maximum possible program and information compatibility of the developed systems;
- c. realization of the functional, information and organizational ties of the systems on different levels within the framework of the existing organization and branch control process;
- d. the maximum utilization of the program equipment and the planning and design solutions available both in the branch and in the other ministries and departments.

The technical base for the functioning automated control systems and the ones newly built will be the branch network of computer centers formed at the present time and equipped with computers from the integrated system. It is proposed that the possibilities of remote access and remote processing will be realized at the fastest possible rates so that in the future a distributed data bank and centralized control of the resources of the branch network of the information computer system can be realized.

The software is being created in the form of a united branch library including divisions for packages of applied programs of a general systems nature and packages of applied programs for the solution of basic sets of functional problems of the motor transportation automated control systems. Primary attention is now being given to the standardization and the unitization of the programs and algorithms, the basis for which is the branch library of algorithms and programs. Here the functional possibilities of the created automated control systems will expand to ensure operative control and planning of the hauling and shipping processes, technical-economic branch planning, the organization of material and technical supply. One of the main things is a significant improvement in the proportion of problems of an optimization nature. No less significance is attached to the processing of the primary documents and initial data on the enterprise level, inasmuch as the quality of its performance to a significant degree determines the reliability of the information reaching the upper echelons of control. In the current 5-year period, basically primary data processing will be done on computers. The key problem to information support which must be solved is standardization of the methods and forms of encoding the information on the basis of united branch and all-union classifiers and also standardization of the documents.

Along with the fulfillment of specific goals stated by the 5-year plan, it is necessary to create the scientific and technical potential which must serve as the foundation for the continuous development of automation in the branch for the next 10-15 years. Accordingly, the Ukrainian SSR Ministry of Motor Transportation attaches great significance to the establishment of the actual relations with the organizations of the academy of sciences and the scientific research organizations of the USSR Ministry of Instrumentmaking, the Ministry of the Radio Industry and the Ministry of Communications. At the present time there are a number of agreements on the joint performance and coordination of operations with respect to creating the automated control systems on a republic scale and also between the ministries of the RSFSR, Belorussia and the Ukraine. In our opinion, the agreement with the Cybernetics Institute of the Ukrainian SSR Academy of Sciences by which it has taken on the scientific direction of automation in the Ministry of Motor Transportation of the Ukrainian SSR has great significance. For the practical realization of coordination and direction of the operations under the management of the Ministry of Motor Transportation of the Ukrainian SSR a coordination council and working group of primary directors of the upper and middle administrative elements have been created to implement the introduction of the automated control systems.

The execution of the investigated work program requires the solution of a number of serious problems of a scientific and organizational nature. The time has come to develop the basic principles of the construction of the united branch automated control system combining all levels of control and encompassing all the production and administrative organizations, and on the basis of these principles a long-term set of target programs for the development of automation, the application of computers and mathematical-economic methods.

The successful development of the automated control systems in motor transportation of the Ukrainian SSR depends to a significant degree on the solution of the problems of equipping the computer centers and automated control systems that are set up with the required peripheral equipment (including subscriber panels for the administrative personnel on the middle and upper levels of administration); organization of the data transmission network; material incentives for the operation of the information computer center with respect to the development and introduction of automated control systems; the organization of the industrial manufacture of the devices providing for direct pickup of information about the operating parameters of the motor transport means from these means themselves.

It is possible to solve these problems most efficiently on the national scale.

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CSO: 1870

UDC 62-52:681.3.06.78

AUTOMATED CONTROL SYSTEM IN RIVER TRANSPORTATION

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 3, May/Jun 78 pp 120-123

[Article by V. V. Nevolin; submitted 31 December 1976, revised 10 February 1978]

[Text] The primary goal of the development and introduction of the Rechflot river fleet automated control system is improvement of the operating efficiency of river transportation. The Rechflot automated control system is a set of specific interconnected control systems: the Rechflot branch automated control system on the level of the central administrative apparatus of the Ministry of the River Fleet, the Parokhodstvo [steamship line] automated control system (hereafter also the BUP automated control system on the basin route administration level), the Port automated control system (hereafter also the SRZ automated control system on the ship repairyard level).

The basic assignments with respect to the introduction of computer engineering and the creation of the automated control systems were laid out in the Ninth Five-Year Plan and are being implemented in the 10th Five-Year Plan. Thus, the first and second phases of 13 automated control systems of different levels have been developed and introduced into operation within the framework of the Rechflot [river fleet] automated control system. On the basis of the Main Computer Center of the Ministry of the River Fleet, 5 automated control systems have been created: the first phases of the branch automated control system (4 subsystems, 20 problems); the Moscow Steamship Line automated control system (3 subsystems, 10 problems); the Moscow southern and northern ports automated control system (5 subsystems, 22 problems, and 4 subsystems, 13 problems, respectively). In 1977 the first link of the automated control system for the Moscow West Port was put into industrial operation. The automated control systems for the Volga Associated River Steamship Line (6 subsystems, 9 problems), the Kama and Gor'kiy ports (2 subsystems, 5 problems, and 2 subsystems, 13 problems, respectively) have been introduced. Since 1975, the automated control systems have been operating for the steamship line of the northwest basin and Leningrad Port. The first phase of the automated control system for the Volgotanker Steamship Line is in operation (5 subsystems, 13 problems). In 1977, the first phase

of the automated control system for the Belomorsko-Onezhskoye Steamship Line (4 subsystems) began operation on an industrial level. Two subsystems of an automated control system have been put into experimental operation in Osetrovskiy Port in 1977. Their industrial operation is planned by the opening of navigation in 1978. All of the computer centers of the Ministry of the River Fleet are equipped with Minsk-32 and YeS-1022 computers.

Let us briefly discuss the characteristic of the automated functional subsystems introduced at the steamship lines, ports and central administration.

The subsystem for operative control of the observation of the norms for the presence of the fleet and calculation of the lease payments has found the greatest use in the operating practice of the steamship lines. This subsystem operates in all of the steamship lines, with the exception of Volgotanker. In the given subsystem information is gathered and processed with respect to the fleet exchange from 11 points. The subsystem handles 2.5 million characters at the input daily, 1.58 million at the output and 2 million once every 5 days. As a result of the functioning of the subsystem, the time for performing the calculations on the fleet leasing has been reduced by 25.5 days. The savings from accelerating the turnaround time of the circulating capital was 240,000 rubles in 1976, and it was 229,000 rubles in 9 months of 1977. In addition, the information on the daily presence, the reception and transfer of the fleet permits operative achievement of a reduction in its turnaround time basically as a result of reducing the mooring time waiting for freight-handling operations. As a result the savings in operating expenses with respect to the fleet on the Volga Associated River Steamship Line amounted to 156,000 rubles in 1976 and 126,000 rubles in 9 months of 1977. In the Kama River Steamship Line the average actual turnaround time of the ships during the 1977 navigation period became 5 percent lower than planned for the motor vessels, 25 percent with respect to makeups, and 10 percent with respect to the nonself-propelled fleet. In the Moscow River Steamship Line the loss coefficient with respect to nonproductive idle time was reduced from 0.5 (1976) to 0.4 (for 9 months of 1977).

The second subsystem within the composition of the Parokhodstvo [steamship line] automated control system with respect to degree of utilization is the subsystem for operative accounting and analysis of the fleet operation. It functions on an industrial level in the Volga Associated River Steamship Line, in Volgotanker, the Northwestern, Belomorsko-Onezhskoye and Moscow river steamship lines. Information from 4,000 ships in the amount of more than 500,000 characters is processed daily. The volume of output documents is more than 60 million characters. The functioning of this subsystem has made it possible to raise the level of administration of the fleet operation as a result of more reliable and timely operative and statistical information with separation of the transport process with respect to elements.

The annual cost benefit for two navigation seasons according to the steamship line data amounted to 310,000 rubles.

The subsystem for calculation of the fleet movement schedule made up of the set of optimization problems is functioning on an experimental and industrial level in the three steamship lines (the Volga Associated line, the Kama line and the Volgotanker): calculation of the fleet utilization plan for the navigation period, calculation of the towing servicing of the ships and make-ups, calculation of the operating economic indices with respect to classes and types of the fleet, and so on. The functioning of this subsystem in the Volga Associated River Steamship Line in 1976-1977 made it possible to reduce the towing requirement and to save operating costs for maintenance of the unattached tug and nonself-propelled fleet by 33,000 rubles.

The subsystems for control of freight and commercial operations and the control of financial resources are functioning on an industrial scale in two of the steamship lines (the Volga Associated River Steamship Line and the Volgotanker). This has made it possible to reduce the times required to calculate and compile the reports and to obtain 40,000 rubles of savings effects in the period from 1976 to 1977.

In the Volga Associated River Steamship Line and Belomorsko-Onezhskoye Steamship Line there are two subsystems in operation: "operative accounting for freight and passengers" and "monitoring of document execution." The first of them provides for daily processing of the information in a volume of 344,000 characters from 25 ports and the generation of 6 output forms with a volume of 750,000 characters. The subsystem has significantly increased the information support of the steamship line service workers for making well-founded decisions.

A member of accounting and analysis programs are operating in the Volga Associated and Northwestern river steamship lines for the operation of the passenger fleet from the subsystem for "control of passenger hauling." With respect to the Northwestern Steamship Line provision is made for gathering and processing information with respect to the passenger fleet at 11 ports with a total volume of 25,000 characters. In the Volga Associated River Steamship Line information is being processed every 10 days on the passenger fleet in a volume of 132,000 characters. The subsystem provides for the operative monitoring of the fulfillment of the plans by the ships. It permits operative reaction to a change in the passenger flows and it makes it possible to perform an objective analysis on the operation of the passenger fleet.

In addition to the above-enumerated subsystems, the following functioned on an industrial scale in the Volgotanker Steamship Line during the 1977 navigation period:

a. "Control of technical operation and maintenance of the fleet" (the indices are calculated for the level of technical operation and maintenance of the fleet by ships, engineer instructors, ship repair plants and on the whole with respect to the steamship line). The calculations of the cost benefit were not performed because of the great labor consumption involved;

b. "Control of industrial activity" as part of the set of problems of compiling united repair departments of current and medium repairs of all designs in the system of the Ministry of the River Fleet (the workers in the estimating groups were relieved of routine operations, and the number of output documents which could not be obtained without a computer expanded). The cost benefit in 1977 was 30,000 rubles;

c. "Provision for safety of the steamship line" as part of the set of programs for accounting and analysis of emergencies in the fleet (automated accounting for emergencies and accidents; the further possibility of prevention of them manifested itself);

d. The "bookkeeping accounting and reporting" subsystem has found broad application in the Volga Associated River Steamship Line. It processes information from 36 ports and enterprises of the steamship line in the amount of 554,000 characters quarterly. As a result, the times for compiling the summary report with respect to the steamship line has been reduced by 2 days, and the quality of the reports has been improved as a result of the program search and exclusion of omissions.

The subsystem for "control of foreign shipping," made up of the set of problems for calculating the disbursement reports, is operating successfully on an industrial scale in the Belomorsko-Onezhskoye Steamship Line. The operativeness of the calculations has been improved by sevenfold, and the annual cost benefits amount to 9,600 rubles.

An effective subsystem as part of the automated control system for "accounting and analysis of the fleet handling in port" is operating on an industrial level at six ports: Moscow Southern, Northern, Western; Gor'kiy, Leningrad and Osetrovskiy). On the average, information is gathered daily with respect to each port on the handling of 80-90 ships in a volume of 35,000 characters. As a result of the operativeness, timely informativeness of the state of affairs at the docks, the cargo areas for processing the ships, in 1977 the mooring time with respect to the fleet in the given ports was reduced on the average by 8-10 percent with a savings of operation and maintenance expenditures of 30,000-35,000 rubles.

The overall annual cost benefit from the functioning of the enumerated automated control systems of the steamship lines and the ports in 1977 was more than 800,000 rubles.

The first phase of the branch automated control system for river transportation (the Rechflot branch automated control system), made up of four subsystems--"operative accounting for freight shipping," "calculation of the annual shipping plan," "calculation of the fleet schedule for the central and northwestern basins" and "scientific-technical information and organization of control"--was proposed by the State Interdepartmental Commission for acceptance, and the subsystems were put into industrial operation at the end of 1975.

The functioning of the first phase of the Rechflot branch automated control system along with the traditional methods of branch control implements a number of other methods and is aimed at further improvement of accounting, analysis and planning of the shipping of freight and passengers on river transportation. At the present time work is being done (technical assignments, technical and operating planning) on the creation and introduction of additional, most important and necessary subsystems of the Rechflot branch automated control system on the level of the central administrative apparatus, including the following: "operative monitoring and regulation of the operation of the fleet of the steamship lines of the central and northwestern basins," "calculation of the technical operating plan of the steamship lines of the central and northwestern basins," "port administration," "administration of the passenger hauling," "control of the material and technical supply," "control of financial activities," "planning, accounting and analysis of the makeup and movement of personnel." With respect to the individual subsystems listed above a number of problems have been introduced.

Thus, the industrial operation of the subsystem for "operative monitoring and regulation of the operation of the fleet of the steamship lines of the central and northwestern basins" introduced in 1977 made it possible to improve the methods of operative monitoring and regulation of the ship traffic in the adjacent steamship lines of the central and northwestern basins. The times for gathering, processing and transmission of the information on the fleet located in these basins have been reduced by 25 percent. This has made it possible to improve the quality of the control of the fleet operation, including the rhythmicity of its operation.

On the whole, throughout all of the subdivisions of the ministry more than 2.9 million documents are computer processed. Without the operation of the information computer center it is already now impossible to ensure normal operation of the steamship lines of the central and northwestern basins.

At the present time the execution of the prospective program for the creation of the Rechflot automated control system is continuing. Primary attention is being given to improving the effectiveness of the operated and introduced subsystems, expansion of the composition of the solved problems, completeness of mechanization and automation of the engineering and administrative work, improvement of the quality and acceleration of the developments and introduction of automated systems.

During the 5-year period, along with the development of the existing organizations, five or six new computer centers will be built in the production organizations. The construction of two group computer centers is beginning in Gor'kiy and Novosibirsk. Computer centers will be built in Astrakhan', Arkhangel'sk and Rostov-na-Donu. All of the computer centers will be equipped with third-generation computers. The communications means have found significant development. Thus, the organizational communications lines have been set up: the Main Computer Center--central administrative apparatus of

the Ministry of the River Fleet; Main Computer Center of the Northwestern Basin Steamship Line--Northwestern River Steamship Line, which are equipped with the medium-fast Akkord-1200PP and Minsk-1500 data transmission equipment. The communications organization lines: Main Computer Center--steamship lines of the Ministry of the River Fleet, Computer Center of the Volga Associated River Steamship Line--ports, Computer Center of the Volgotanker Steamship Line--rayon administrations, Computer Center of the Northwestern Steamship Line--Leningrad river port, are equipped with the T-63 telegraph. Twice as many capital investments as in the last 5 years have been directed toward the development of the material and technical base for the automated control systems in the current 5-year period.

The plan calls for implementation of the principle of standard planning and design and carrying out the development of standard plans for the automated control systems for river steamship lines--on the basis of the Volga Associated River Steamship Line, for the automated control systems of the river ports--on the basis of the Moscow Southern and Leningrad river ports.

The basic area for automation of control in the branch in 1980-1990 will be staged development and execution of the automated control systems on two levels of administration with the creation of cross functional subsystems. The effectiveness of the operated and developed subsystems will be improved by expanding and increasing the number of optimization problems. The Rechflot automated control system must provide for operative control of the transport process with implementation of the model of the location of the ships in the basin on the computer, improvement and acceleration of the handling of the ships in the ports and mechanization of the filling out of transport documents. The most important phase of this work must be the solution of the problem of operative 10-day planning of the work of the fleet in the steamship lines.

Since 1980 provision has been made for the beginning of the development of the automated control systems for ship repairyards which will make it possible to reduce the idle time of the fleet in repairs and improve the repair quality. In the future of river transportation the plan calls for the introduction of eight developed automated control systems and four newly created ones in the ports and at the repairyards, ten developed and six newly created automated control systems in the steamship lines and a developed automated control system in the central administrative apparatus of the Ministry of the River Fleet. Provision is made for equipping the computer centers with third- and subsequent generation computers with enlarged ready-access memories.

By 1990 a broad complex program is to be implemented with respect to improvement of the administration of the transport process, encompassing aspects of an economic, organizational, social and technical nature which will provide for further stable growth of the operating efficiency of river transportation and improvement of servicing of the population, industry and agriculture.

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UDC 62-52:681.3.06.2./19

PRINCIPLES OF CONSTRUCTING A UNITED ALL-UNION AUTOMATED SYSTEM FOR ALLOCATION OF SEATS ON AIRCRAFT

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 3, May/Jun 78 pp 123-125

[Article by V. A. Zhozhikashvili; submitted 31 December 1976, revised 20 February 1978]

[Text] The prospective plan for the development of civil aviation includes the problem of the creation of a united all-union automated system for seat assignments on aircraft. The beginning of this work was the introduction of the Sirena system into operation in 1972, which controls the seats on aircraft flying out of Moscow airports. The experience in the construction of the Sirena system proved the effectiveness of the systems of the investigated class in practice.

The automated seat assignment systems for aircraft (reservation systems), which operate in direct contact with the customers, operate in the real time mode with highly rigid restrictions on the reaction time. The interaction of the operator-agent with the system is a man-computer dialog. The reservation systems realize operative distribution of limited resources--the seats on aircraft. The distribution of resources requires storage of large volumes of intensely variable information in the computer memory.

Any reservation system is characterized by volumetric and functional indices. The volumetric indices reflect the volume of the resource control by the system, for example, the number of places on the aircraft multiplied by the number of presale days. The functional characteristics are a set of technological process procedures performed by the system.

Let us call this type of reservation system full-valued and full-functional, which automates the entire investigated process in quantitative and qualitative respects. If the concept of being full-volume is sufficiently understandable, then it is necessary to make a few remarks with respect to the concept of full-functionality.

It would be improper to mention the full-functional system realizing all of the servicing procedures executed in the nonanimated systems. The latter quite completely execute control only on the lower level, that is, direct distribution of resources. The upper-level control procedures--optimization procedures--are not in practice performed in such systems. Procedures are now already known which can be executed only by computer, for example, operative selection of the optimal flight paths. As the reservation systems are developed, the proportion of optimization procedures will increase. Thus, although the content of the concept of complete functionalness will vary as our knowledge of the automated process develops, this concept currently includes an entirely specific content.

The calculations indicate that the fully functional system of reserving seats on aircraft can require the performance of no less than 50,000 operations per second for every million passengers per year. If we design a completely functional system for 200 million passengers per year, it is necessary to perform 10 million operations per second and 2,000-4,000 references per second to the external memories.

It is proposed that the arrangement of the computers within the limits of the country be accomplished considering the existing structure of control developed in the branch. The control centers for the all-union reservation system will be located in the main cities of the territorial administrations, in direct proximity to the control computer centers. This facilitates the required information interaction with the other automated control systems. Thus, the zonal principle of construction of the system is implemented. It corresponds to the nodal nature of air routes with a small number of intermediate landings and the trend toward a reduction of them, in contrast, for example, to railroad lines with a large number of intermediate stations.

The territories located in a zone are divided into several groups. The first group is made of cities in which local automated control centers are located for seat allocation on the aircraft. For the flights over a complex route, the local control center will reference the zonal center for information.

The second group is made up of the cities not having their own control center and transferring control of the seats on the aircraft to the zonal center. The third group is made up of cities not having their own airport. These cities will reference the zonal or local centers for seats. Until the full-volume system is created the cities realizing autonomous control of seats on trips from their airport will be preserved. The information exchange with respect to the interzonal flights will be carried out using the intercomputer exchange on the level of the zonal centers.

The local and zonal control centers require the application of computers with various output capacities. In addition, the zonal control centers differ sharply from each other. Under these conditions, it is useful to

have a standard series of control centers differing with respect to power. One of the possible solutions consists in the use of small and large computers to organize the control centers. The calculations indicate, for example, that the control centers designed for servicing a million passengers a year can be constructed on the basis of an SM-2 computer. Here the system can contain several dozen terminals. The control center designed for servicing up to 2 million passengers per year is executed on a medium-capacity computer. The number of terminals can reach 300. The large control centers can be efficiently constructed on the basis of the group of small and large computers. The like nature of the problems solved at the centers of various capacity will permit use of the same user programs.

An important role in the reservation systems is played by the network for communications, orientation to the video terminals and teletypes. The video terminals are more perspective. Their application is completely justified in the Sirena system [1].

The communications networks satisfying rigid time requirements (the proportion of the reaction time of the system or the communications network must not exceed units of seconds) are constructed on special principles in contrast to the general-purpose network. Therefore, for the reservation systems, specialized inhouse networks are organized. This approach is characteristic of international practice. One of the conditions of the implementation of such networks consists in limiting the number of retransmissions when routing the messages.

The zonal and interzonal levels are distinguished in the communications network of the national aircraft seat reservation system. Approximately 75 percent of the information circulates on the zonal level. The zonal network basically has a radial structure which is oriented toward the zonal center. Several bypass routes organized to improve the reliability of the delivery of the messages do not interrupt the radial structure of the network. The interzonal network has a loop structure.

The communications network of the system is organized on the basis of the information junctions which are divided into two groups: the peripheral information junctions and the central information junctions. The peripheral junctions are installed at the zone cities, and they play the role of message concentrators. The system of radial (two or multiple) channels joins the terminals to the peripheral junctions which, in turn, are connected to the central junction of the zone. Any terminal of the zone is connected to the central junction either directly or through intermediate junctions.

The central junction is located in direct proximity to the zonal control center; its computers perform the functions of the message commutators and channel processors. For this purpose, the central junction is connected by a fast communications channel to the computer of the control center and the main channels with several central junctions of the other zones. Some of the central junctions are connected to each other directly and others through

the intermediate junctions, the total number of which must be strictly limited. The basic volume of the messages are connected to the central junctions with a maximum of one retransmission.

The information junctions are realized on a set of two or several SM-2 computers supplemented by modules for coupling several versions for working with synchronous and asynchronous communications channels of various types and speeds. For using the SM-2 computer, a problem-oriented package of programs has been developed as the message commutator [2].

The communications channels of the reservation system are equipped with data transmission equipment of several types, depending on the configuration of the message transmission channel, the modulation speed and the channel use regime. The adaptability to operation in real time in the dialog mode is common to all versions of the data transmission equipment.

In the new system, just as in the Sirena system, the basic type of operator panel will be the video terminal. The new operator panel is designed for transmission and depiction of longer messages, and it has large possibilities for the delivery of information and editing means; the operator panel will contain an improved high-speed printer.

At the time of writing this article, the first phase of the all-union system for reserving aircraft seats looks like the following. It is proposed that the first two control centers be installed in Moscow and Riga. The volumetric indices for 1980 amount to 15 million and 1 million passengers per year, respectively. The Moscow center will be organized on the basis of the group of SM-2 and M4030 computers. The Riga zonal center is realized on the basis of two SM-2 computers. It is proposed that the functions of the two centers be expanded by comparison with the Sirena-1 system. The trips with transfers, intermediate landings and return trips will be monitored. The procedures for servicing the passengers will be supplemented by filling out advance requests and reservations with storage of the information about the requests and reservations in the computer memory. It is also proposed that the function of accompanying the transit passengers and improvement of the procedure for tracking the delayed trips be introduced.

Both centers will be connected to each other for the exchange of information on through trips and for filling out tickets for return flights. Along with the manipulator panels of the Sirena-1 system the new video terminals which are gradually replacing the panels will also be used.

The first phase of the system is the base for broad circulation and development. The realization of such a large-scale project as the plan for creating the all-union aircraft seat reservation system requires the solution of a number of scientific and engineering problems and organizational problems. Among the scientific problems are the development of mathematical methods of constructing the system on the macrolevel, including the problems of the optimal placement of the control centers and information junctions within the

boundaries of the country and optimization of the topology of the communications network. It is possible also to consider in this group the problems of the description of the reservation systems by the methods of queuing theory. Even when using the decomposition methods it is necessary to deal with very complex models containing a set of different instruments. Some of the approaches to the solution of these problems are discussed in [3].

The experience in the operation and maintenance of the Sirena-1 system and also the calculations indicate that the broad application of automated reservation systems provides a significant socioeconomic effect both from the point of view of improving the servicing and mass saving of time on the part of the population and with respect to utilization of the aircraft fleet.

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CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

SEMINAR-CONFERENCE ON AUTOMATION OF DESIGN OF RADIOELECTRONIC EQUIPMENT

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 3, May/Jun 78 p 140

[Article by A. Ya. Tetel'baum]

[Text] The Fifth All-Union Seminar-Conference on Software and Hardware for the Automated Design Systems for Radioelectronic Equipment was held in Tsakhkadzor (Armenian SSR) from 1 to 10 March 1978. The seminar was organized by the USSR Ministry of Higher and Secondary Specialized Education, the Moscow Aviation Institute imeni S. Ordzhonikidze, the Moscow Institute of Electronic Machinebuilding, the Leningrad Electrotechnical Institute imeni V. I. Ul'yanov (Lenin) and the Central Board of the Scientific and Technical Society of the Instrumentmaking Industry.

The problems of the architecture of the automated design systems (SAPR), their software, methods of technical and logical design, simulation and optimization of the electronic circuitry, the elemental base of high-speed computers and also the ways and prospects of designing computer engineering means based on microprocessors were investigated at the seminar.

The seminar was participated in by 140 specialists from various organizations of the USSR. Forty-eight lectures and reports were heard and discussed. During the course of the seminar the engineering and technical workers and the scientific coworkers of the enterprises, scientific research institutes, design offices, academic, planning and training institutes were familiarized with the modern methods of automation of the design of radioelectronic equipment. They also exchanged work experience.

The work of the seminar was opened by chairman of the organizational committee, Prof P. P. Sypchuk (Moscow Institute of Electronic Machinebuilding), who emphasized the urgency of the problem of the automation of design of radioelectronic equipment and reported on the creation of a coordination council within the framework of the Ministry of Higher and Secondary Specialized Education of the USSR for problems of design automation. It is unquestioned that the function of the given council will be to promote further progress in the field of creating automated methods of designing radioelectronic equipment and faster introduction of the results of the scientific work performed at the institutions of higher learning of the USSR.

The participants in the seminar listened attentively to the lectures by the leading scientists of our country on the most important and urgent problems of the automation of design of radioelectronic equipment. The reports by the participants in the seminar were also discussed. The following lectures and reports aroused special interest: "Prospects for the Design of Microelectronic Equipment and Problems of Training Engineering Personnel" by B. F. Vysotskiy, "Prospects and Problems of the Automation of the Design of Radioelectronic Equipment" by N. Ya. Matyukhin, "High-Output Computer Systems" by E. V. Yevreinov, "Algorithmic Model of Systems Engineering Synthesis of Electronic Circuits" by Ye. L. Glorizov and P. P. Sypchuk, "Organization of Software for Optimal Decisionmaking" by D. I. Batishchev, "Principles of the Organization of the Information Support Subsystem for the Information Support of the System for Automation of the Design of Radioelectronic Equipment" by V. I. Anisimov, P. D. Batakovski and Yu. Ya. Pavlov, "Representation of Information in the Automated Design System" by L. B. Abraytis, R. I. Sheynauskas and A. V. Zhilevichyus, "Architecture of the Subsystem for Automation of the Design of the Topology of Electronic Circuits" by V. A. Selyutin, "Mathematical Models in the Design of Radioelectronic Equipment Circuitry" by V. M. Kureychik, "Some Operations of Systems Software" by V. P. Panferov and I. M. Medov, "Symbolic Methods in the Automation of the Systems Engineering Design of Electronic Circuits" by Ya. K. Trokhimenko, "Application of the Methods of Structural Programming in the Development of Software for the Automated Design System" by Ye. I. Gurchich, "Technical Means of the Design and Manufacture of Electronic Equipment Based on Microprocessors" by A. G. Aleksenko, "Solution of the Standardization Problem" by K. V. Sapozhkov, A. M. Bershanskiy and A. B. Shcherban', and so on.

In addition, discussions were held with respect to a number of urgent problems, among which we shall mention, for example, discussion of the topic: "Basic Problems of Science at the Institutions of Higher Learning in Modern Times."

The participants in the seminar summed up the work done for the year. They noted the prospective approaches to the solution of a number of problems and new trends in the development of both the methods of automated design and the modern elemental base. All of these problems have found reflection in the resolutions adopted at the seminar.

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PROBLEMS OF DEVELOPMENT OF SOFTWARE FOR CONTROLLING THE COMPUTATION PROCESS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 3, May/Jun 78 p 141

[Article by B. N. Pan'shin]

[Text] From 11 to 14 April 1978 the Republic House of Economic and Scientific and Technical Propaganda and the Cybernetic Institute of the Ukrainian SSR Academy of Sciences held a seminar in Kiev on the "Problems of the Development of Software for the Control of the Computation Process," the work of which was participated in by more than 170 representatives out of 98 organizations of the country. Thirty-two reports were given at the seminar which considered the software of the information-dispatch systems of various levels, multimachine complexes, administrative control systems for the resources of the VTsKP and also optimization of the computer process.

Great interest was aroused among the participants in the seminar by the reports devoted to the software for the collective-use systems and improvement of the efficiency of utilizing the computer engineering means. The report "Problems of the Development of Software for Control Systems for the Information Computation Processes" (A. A. Stogniy, G. I. Fursin and B. N. Pan'shin--Cybernetics Institute of the Ukrainian SSR Academy of Sciences, Kiev) was devoted to the problems of the creation of control program complexes for the organization of the computer process and support of the interaction among them within the framework of the information-dispatch service of the computer network.

In the report "Some Problems of the Distribution of Computation Capacity in the Territorial Automated Control System" (Yu. M. Cherkasov, Ye. A. Trushin and G. A. Loskutov--GlavNIVTs of the Mosgorispolkom) a study was made of the program for implementation of the collective form of operation of the computer resources with combination of territorial and branch principles of control of the computer engineering means.

The report "Software for the Multimachine Complex" (A. I. Nikitin, G. S. Serykov and A. Ye. Selyuchenko--Cybernetics Institute of the Ukrainian SSR Academy of Sciences) contained an analysis of various approaches and principles of the development of the operation system of multimachine complexes.

The development of the package of programs automating the administrative functions of control of the computer means at the VTsKP (based on the YeS-1010 computer) was described in the report "Administrative Control System of the VTsKP" (A. Ye. Kulinkovich and A. F. Tutov--Cybernetics Institute of the Ukrainian SSR Academy of Sciences).

In the report "A Set of Programs for Solving the Problems of Optimization of the Computation Process" (M. D. Babich, L. B. Shevchuk and L. N. Gritsak--Cybernetics Institute of the Ukrainian SSR Academy of Sciences) a study was made of the principles of the effective utilization of the libraries of applied programs for solving complex problems; these principles were implemented in the set of programs for the BESM-6 computer which are in experimental operation at the Computer Center of the Cybernetics Institute of the Ukrainian SSR Academy of Sciences.

The package of programs for compiling the schedules for performance of operations on the computer the basis for which is the algorithm for the branch and boundaries method was proposed in the report "Problems of the Investigation and Development of the Program-Algorithmic Apparatus for the Solution of the Problems of Scheduling Theory" (G. A. Kozlik, V. M. Karas' and I. A. Kirillov--Automation Institute, Kiev). The package was turned over to the Republic Library of Algorithms and Programs.

The report "Development of Procedural Materials for the Application of the OKA and the KAMA Systems in Automated Control Systems" (G. P. Mandrusova, S. F. Manovich and V. V. Tyurin--Cybernetics Institute of the Ukrainian SSR Academy of Sciences) investigates the developed procedural materials which promote a reduction in time and improvement of quality of the design work in the stage of technical design of data processing systems.

The reports on the packages of programs in experimental operation and already introduced were heard with great interest: "Means of Controlling the Process of Working With the Libraries in the OS YeS" (S. I. Palamarchuk, T. G. Bol'batenko, V. I. Ignatukha and O. I. Rudenko--NIIASS, Kiev); "Monitoring the Fitness of Programs in the R-Programming Process" (I. V. Vel'bitskiy and O. V. Malyshev--Cybernetics Institute of the Ukrainian SSR Academy of Sciences); "Experience in the Development of a Package of Accounting Programs for Operation With the OS YeS" (N. Ye. Popenko--Cybernetics Institute of the Ukrainian SSR Academy of Sciences).

Interest was also aroused by the reports on "Software for Organization of the Reporting of the Computer Load at the University Computer Center," "Organization of the Operative Control of Computer Reserves in Data Processing Systems" and "Collective-Use Dispatcher of the Computer Center (DKP VTs)," which were given by coworkers of the Cybernetics Institute of the Ukrainian SSR Academy of Sciences L. K. Snigirev, A. Yu. Stepanenko, A. R. Il'ves and Yu. A. Koshmak.

The business of the seminar and the practical direction of the reports gave rise to an animated exchange of opinions on the discussed developments and made it possible to take note of a number of new areas in the field of the creation and introduction of software for the organization of control of the computation process. The published topics of program reports promoted the fruitful work of the seminar.

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USE OF TWO DISKS IN PACKAGE PROGRAM PROCESSING DOS GENERATED FOR ONE MAGNETIC DISK OF M6000 COMPUTER

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 3, May/Jun 78 inside back cover

[Article by V. I. Makeyev]

[Text] It is well known to the users of the package program processing DOS of the M6000 computer that when generating the DOS on two disks, 53 cylinders are used on the second disk (the information byte corresponding to the number of tracks used in the system does not permit more).

On the zero page of the ready-access memory a group of cells (154-157) are allocated which contain the disk numbers and the number of tracks. Cell 160 contains the next available address (track section) of the user files on the disk. The contents of this cell determine the lower limit of the working region of the disk. If the contents of these cells are varied in a defined way it is possible to achieve use of all of the cylinders of the second disk. Here the DOS is generated for one disk of modules for the Al3l-3 processor.

It is proposed that two subroutines DISK2 and DISK1 be used. Before referencing the second disk in the user program it is necessary to call the DISK2 subroutine. The instruction sequence is as follows:

```
JSB DISK2;  
DEF*+3 (return address);  
DEFm (parameter address in which the user forms the track numbers and the  
section numbers where the information will be written or read on the  
second disk);  
DEFn (parameter address where the disk number and section number of the sys-  
tem disk will be written).
```

Before referencing the systems disk it is necessary to call the DISK1 subroutine. The instruction sequence is as follows:

```
JSB DISK1; DEF*+3; DEFm; DEFn.
```

ASMB,R,B,L,T	ASMB,R,B,L,T
HED JMCK2	HED JMCK1
NAM DISK2,6	NAM DISK1,6
ENT DISK2	ENT DISK1
DISK2 NOP	DISK1 NOP
LDA DISK2,I	LDA DISK1,I
SSA	SSA
JMP **+2	JMP **+2
JMP **+4	JMP **+4
AND =B077777	AND =B077777
LDA 0,I	LDA 0,I
JMP *-5	JMP *-5
STA RETRNN	STA RETRNN
JMP ADDRSS	JMP ADDRSS
PROG ISZ DISK2	PROG ISZ DISK1
LDA DISK2	LDA DISK1
CPA RETRNN	CPA RETRNN
JMP DISCI	JMP DISCI
ADA .M1	ADA .M1
STA DISK2	STA DISK1
ADRSS ISZ DISK2	ADRSS ISZ DISK1
LDA DISK2,I	LDA DISK1,I
SSA	SSA
JMP **+2	JMP **+2
JMP **+4	JMP **+4
AND =B077777	AND =B077777
LDA 0,I	LDA 0,I
JMP *-5	JMP *-5
STA ADR,I	STA ADR,I
ISZ ADR	ISZ ADR
JMP PROG	JMP PROG
DISCI LDA DISCO,I	DISCI LDA ADRES,I
STA OCSID	STA DISCO,I
ADA =B20000	LDA ADRES+1,I
STA DISCO,I	STA .160,I
LDA .160,I	LDA AD
STA ADRES+1,I	STA ADR
LDA ADRES,I	JMP RETRNN,I
STA .160,I	ADRES BSS 2
LDA OCSID	DISCO OCT 154
STA ADRES,I	.160 OCT 160
LDA AD	ADR DEF ADRES
STA ADR	AD DEF ADRES
JMP RETRNN,I	RETRNN NOP
ADRES BSS 2	SC EQU 5
DISCO OCT 154	.M1 DEC -1
.160 OCT 160	END DISK1
ADR DEF ADRES	
AD DEF ADRES	
RETRNN NOP	
OCSID NOP	
SC EQU 5	
.M1 DEC -1	
END DISK2	

The use of the DISK2 and DISK1 subroutines can be recommended to all users of the M6000 computer working with the DOS generated from modules for the A131-3 processor. If the DOS is generated from these modules on the A131-7 processor, it is also possible to use these subroutines there.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

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Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No. 3, May/Jun 78  
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