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Secret

Soviet RYAD Computer Program

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SOVIET RYAD COMPUTER PROGRAM

Summary

1. The Soviet Union's computer development program is in serious trouble. For some years, Moscow has been pushing its RYAD program -- a series of third-generation computers -- in an effort to meet the country's enormous data-processing requirements. The program, however, is at least three years behind schedule, and large-scale production is not likely for several years.

2. By modeling RYAD computers after the IBM 360 series, the USSR hoped to save both time and money and make use of the large stock of IBM software. Although the concept was sound, the program has been hampered by shortages of high-quality components, out-of-date production and testing techniques, and absence of effective direction and coordination.

3. The USSR, lacking a solid technological base, persuaded Bulgaria, Czechoslovakia, East Germany, Hungary, and Poland to de-emphasize their own computer plans and help develop some RYAD models. These countries, and the USSR, are now testing prototypes of a few of the models. Only the smaller RYAD models have reached limited-series production or the customer-testing stage. The Soviet Union has the sole responsibility for producing the two largest RYADs, which are roughly comparable with IBM's powerful 360-75 and 360-85. These Soviet computers, however, require special integrated circuits that are being produced in the USSR only experimentally.

4. Although no firm target was ever announced, the USSR apparently was counting on producing from 3,000 to 5,000 RYADs per year by 1975. Probably only a few hundred machines will be produced in that year. Moscow has recognized this fact and has abandoned plans to phase out production of the

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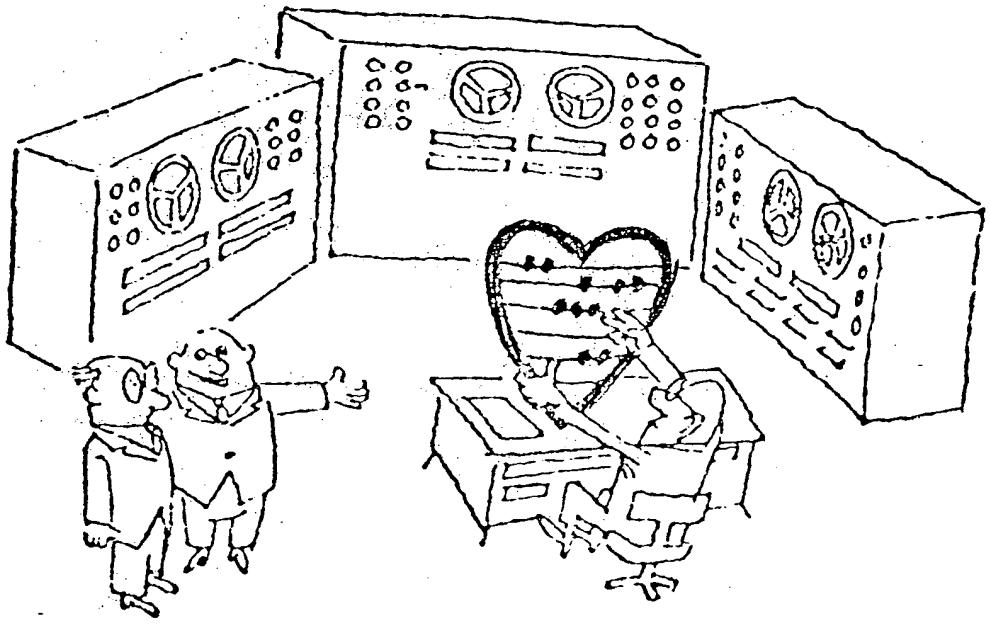
MINSK-32 -- an obsolete second-generation computer. Indeed, output of an improved MINSK-32 is scheduled to reach 900 units annually by 1975. These machines will be the foundation of the automated management systems to be set up during 1973-75.

5. Additional Western help will be a critical factor in determining how fast the Soviet Union can mass-produce a reliable set of RYAD models. The United States, France, the United Kingdom, and Japan already have supplied machinery to manufacture key RYAD components. Despite COCOM regulations, the USSR has acquired much Western technology and machinery to produce integrated circuits. Nevertheless, without additional Western aid, the USSR will find it difficult to mass-produce RYADs during the next plan period (1976-80). Moscow now is seeking to purchase complete automated plants for the manufacture of integrated circuits, magnetic tape and disc packs, disc drives, magnetic cores, and printers. Selected purchases of large machines for high-priority uses and an interest in Western computer programs for industrial applications also can be expected.



"And this is the heart of our computer center."

Discussion

Introduction

6. A new family of third-generation computers, called RYAD, was recently displayed at the Permanent Exhibition of National Achievements (VDNKh) in Moscow. These computers had been scheduled for wide application in industry during the Ninth Five-Year Plan (1971-75). The RYAD program, however, is in deep trouble. This publication discusses the program, its goals, progress, and problems and assesses the prospects for RYAD production through 1975.

Background

7. Soviet computer production has increased very rapidly since 1960 -- about 32% a year* -- and the USSR is currently the world's third largest producer of computers, after the United States and Japan. By US standards, however, the Soviet industry is still small; output of digital computers was about 1,300 units in 1972, compared with more than 20,000 in the United States and about 3,000 in Japan. A comparison of computers in use is even more striking: about 8,500 digital computers in the USSR and more than 100,000 in the United States. The Soviets have imported about 200 computers from the West and probably less than 100 from Eastern Europe.

8. Soviet computer systems differ from those in the United States and in the West in several important respects. All Soviet computers currently in series production are second-generation machines (fitted with transistors). Although some transistorized computers are still made in the United

* According to official data on the ruble value of output. Computer production in the USSR is included under the heading "Means of Computer Technology" (Sredstva Vychislitel'noy Tekhniki), which includes spare parts for computers, peripherals, and possibly non-computer hardware such as calculators. The extent to which ancillary output may distort the actual growth in output of computers cannot be determined.

States, most US production consists of third-generation machines using integrated circuits (ICs). Computers with integrated circuits are generally faster and more reliable than transistorized models and can be built in much smaller sizes and, in the United States at least, at greatly reduced cost.

9. Most Soviet computers are "scientific" machines. Design has been optimized to handle numeric inputs (numbers) rather than alphanumeric inputs (letters, symbols, and numbers). Therefore, Soviet computers are most efficient in engineering applications. Most US computers are general-purpose machines designed for data processing but useful and efficient in engineering applications as well.

10. In performance and reliability, most Soviet computers are obsolete by US standards. For example, the MINSK-32, perhaps the most widely used Soviet computer for data processing, has an average speed of about 25,000 operations per second, has a maximum internal memory capacity of 64,000 words, and can operate, on the average, only 20 hours before failure. Data processing computers currently available in the United States operate at speeds of several million operations per second with mega-word (million-word) memories and can run trouble-free for several hundred hours.

11. Soviet computer peripherals -- tape drives, printers, card readers, etc. -- are greatly inferior to their Western counterparts in quality, design, and performance. Peripherals and supplies (tape, paper, and cards) are a major cause of in-service failure of computer systems and a matter of urgent concern in the USSR.

12. Finally, Soviet computer software systems are primitive by US standards. Generally the Soviets lack transferable high-level languages, application programs, and efficient operating systems software for most of their computers.* In the United States, both computer software and hardware are developed by the manufacturer for the user

* High-level languages such as FORTRAN have the special merit that almost anyone can be trained to write a program; operating systems are software programs that operate the computer.

as an integrated package; in the USSR the user is forced to develop much of his own software. Because Soviet computers are rarely identical, software developed at user facilities is of limited or no value to other users, even to those employing the same model computer.

13. Early in the Eighth Five-Year Plan (1966-70), Soviet planners recognized the need for more advanced general-purpose computers and more efficient software and peripherals for processing economic data. Although no official announcement was ever made, A.A. Dorodnitsyn of the USSR Academy of Sciences indicated to US businessmen in late 1967 that a decision had been made to build a family of modern third-generation machines (RYADs). From Dorodnitsyn's remarks and other information, it was apparent that Moscow hoped to modernize the entire Soviet computer industry relatively quickly.

General Aspects of the RYAD Program

14. The RYAD program is the USSR's first major effort to produce a family of computers designed specifically for economic and data processing applications. The RYAD series is a direct copy of the IBM 360 series machines; technical characteristics of RYADs and IBM 360 computers are compared in Table 1. A comparison of RYAD and other Soviet computers is given in Table 2.

15. The decision to copy IBM, strongly opposed by some who felt it degrading, had two distinct advantages. By using a proved design, the Soviets hoped to avoid costly development programs and reach large-scale production more quickly than otherwise would be possible.* The IBM 360 series program was the most successful effort ever undertaken to develop a family of computers that, though differing in size and capabilities, were mutually

* The task of copying may have been aided by the clandestine acquisition of embargoed 360 series computers and association documentation. This probably decreased the time and effort needed to achieve a Soviet prototype, but the availability of the hardware for inspection does not reduce the effort needed to go from the laboratory to mass production.

Table 1

Technical Specifications of Selected RYAD and IBM 360 Series Computers

	Add Time[1] (Microseconds)	Memory Cycle Time[2] (Microseconds)	Input-Output Rate[3] (Kbytes[5] per Second)	Storage Capacity[4] (Kbytes)
IBM 360-20	58	3.6	160	4-32
ES[6]-1010	200	1	140	8-64
IBM 360-30	40	1.5	400	16-64
ES-1020	25	2	200	64-256
IBM 360-40	12	2.5	800	32-256
ES-1030	6.5	1.25	700	128-512
IBM 360-50	4	2	1,200	128-512
ES-1040	1.4	1.35	1,300	256-1,024
IBM 360-65	1.3	0.75	1,200	256-1,024
ES-1050	0.65	1.25	1,300	128-1,024
IBM 360-75	0.8	0.75	1,300	256-1,024
ES-1060	0.5	0.6	1,300	256-2,048
IBM 360-85	0.16	0.08	1,300	512-4,096

1. Time required to execute one addition.
2. Time required to read and restore a specified number of bits.
3. Maximum speed of input-output operations.
4. Number of units of addressable internal storage available.
5. Kilobytes. A byte is a basic unit of memory used to form words.
6. Yedinnaya Sistema (unified system).

Table 2

Technical Specifications of Selected RYAD and Other Soviet Computers

	Add Time[1] (Microseconds)	Memory Cycle Time[2] (Microseconds)	Storage Capacity[3] (Kbytes)
URAL-11	20	15[4]	4-16
URAL-14	20	29[4]	16-64
URAL-16	10	9	128-512
MINSK-22	12	24	4-8
MINSK-32	25-34	5	16-64
ES-1020	25	2	64-256
BESM-6	1.1	2	16-64
ES-1050	0.65	1.25	128-1,024

1. Time required to execute one addition.
2. Time required to read and restore a specified number of bits.
3. Number of units of addressable internal storage available.
4. Estimated.

compatible. Subject only to hardware limitations on speed and memory size, programs designed for any model in the series can be run on all other models. Soviet computers generally are not compatible with each other. The Soviets also hoped to make RYADs compatible with IBM 360 machines, since this would give them access to a large IBM library of systems software and applications programs. The USSR could also supplement domestic production by importing IBM machines and compatible peripherals manufactured by IBM and other Western firms.

16. The Soviets planned to put RYAD into series production in 1970. This enormously complex undertaking involved the concurrent development of several areas of technology that were poorly developed in the USSR in 1967. Integrated circuits were not being produced serially, nor were multilayer printed circuit boards,* which, together with integrated circuits, are the fundamental building block of third-generation computers. The magnetic disc technology, essential for all RYAD models, was only in early stages of development. To help meet the program's challenge, the USSR turned to Eastern Europe.

Role of Eastern Europe

17. RYAD became a CEMA-wide program under Soviet leadership and control in late 1968, when Bulgaria, Czechoslovakia, East Germany, Hungary, and Poland reluctantly agreed to cooperate with the USSR in the joint development and production of RYAD computers. These countries were already using Soviet computers and were not anxious to increase their dependence on Soviet computer systems. The East Europeans strongly opposed cooperation because they already had computer development programs that were tailored to their special needs. The commitment to purchase RYADs was especially troublesome for Bulgaria, Czechoslovakia, Hungary, and Poland, since they had licenses to produce Western style computers that were not compatible with RYAD. Eastern Europe was first given responsibility for developing software and peripheral

* Used for mounting and interconnecting the ICs.

hardware. By 1970, their role was expanded to include producing central processing units as well.*

18. The East European computer industry is quite small. Poland, with the largest, has produced only about 500 computers during the past 10 years. Nevertheless, capability to produce advanced design computers has improved markedly in recent years through the acquisition of Western computers and computer-related technology. Poland has built prototypes of a medium-sized third-generation computer (ODRA-1305) based on British design and has developed a minicomputer (K-202) based on UK technology acquired illegally. Bulgaria allegedly has acquired French technology to produce integrated circuits for calculators and Japanese technology to manufacture magnetic tape drives. Hungary and East Germany are manufacturing a few third-generation process control computers based on imported components. Poland soon should have the best capability to produce integrated circuits in Eastern Europe, having acquired an integrated circuit production facility from France. Czechoslovakia manufactures ICs in small quantity based on clandestinely acquired US technology.

Models: Characteristics, Uses, Producers, and Prices

19. The RYAD program will have six basic computer models referred to, interchangeably, as the ES or R series. In ascending order of complexity, they are the ES-1010, ES-1020, ES-1030, ES-1040, ES-1050, and ES-1060:

> The ES-1010. Smallest of the RYAD series, the ES-1010's memory and low processing speed restrict its usefulness to simple engineering tasks, teaching applications, and limited process control and data processing operations. It can serve also as a satellite processor for larger RYAD computers in preparing input data or controlling peripherals.

* The central processing unit includes the main memory and arithmetic circuitry.

The ES-1020. Having about the same speed as the IBM 360-30 computer and the Soviet MINSK-32, the ES-1020 will be used for data processing or engineering problem-solving at the enterprise level.

The ES-1030. Several times faster than the ES-1020 and having a memory twice as large, the ES-1030 is about equivalent to an IBM 360-40. It will be used in medium-sized enterprises.

The ES-1040. According to claimed specifications, the ES-1040 is a large computer, roughly comparable with the IBM 360-50. It is large enough to accommodate multiprogramming and time sharing and will be used by production associations or regional computer centers for complex economic and scientific problems.

The ES-1050. Faster than the ES-1040 but having the same maximum memory size, the ES-1050 is the counterpart of the IBM 360-65. It is to be used for planning at the Republic or All-Union level.

The ES-1060. With a planned speed of 2 million operations per second and a maximum memory of 2 million bytes, the ES-1060 compares with the largest IBM 360 computers. It will be used at the highest levels of government for the most demanding planning, economic, and scientific (e.g., weather prediction) problems.

About 150 models of the approximately 20 basic types of peripheral machines will be produced in the USSR and in Eastern Europe for use with RYAD. Some types -- magnetic disc storage systems, video terminals, plotters, and alphanumeric optical readers -- are not yet in production in the Soviet Union, while other peripherals currently in production will be redesigned and improved substantially for RYAD use.

20. All RYAD models, except possibly the ES-1010 minicomputer and the ES-1040, are under development in the USSR. The very largest machines,

the ES-1050 and ES-1060, are being developed exclusively by the USSR and the others jointly with Eastern Europe. Hungary is building the ES-1010 with the help of a licensed French design* that has been modified extensively to meet RYAD compatibility standards. The ES-1020 is Bulgaria's responsibility, although versions with greater speed but smaller memories are being developed in East Germany (ROBOTRON-21) and in Czechoslovakia (ZPA-6000/20). Poland is developing the basic model of the ES-1030, and Czechoslovakia is designing a modified version -- the ZPA-6000/30. East Germany is the only country working on the ES-1040. The principal development production centers for RYADs in the USSR and Eastern Europe are shown in Table 3.

21. The prices available for two RYAD systems are surprisingly high. The ES-1030 is priced at about 900,000 rubles ($1,242,000).** The ES-1050 is priced at 3.5 million rubles ($4,830,000).** For comparison, rough counterparts in the IBM series -- the 360-40 and 360-65 -- cost about $250,000 and $1.7 million, respectively.

22. The high RYAD prices reflect the high costs of prototype production. The price of the ES-1050 seems low relative to that of the ES-1030, suggesting that the bigger models in the RYAD series may be subsidized. The price of the ES-1050 is about four times that of the ES-1030, whereas, for IBM, the price of the larger model is about seven times the smaller one.

23. Until production costs decline with expanding production and unless the USSR's State Commission on Prices decides to cut prices, some users of computers will find RYAD prices non-competitive with those of existing second-generation machines. V.M. Glushkov, a leading Soviet computer authority noted that: "some third-generation (RYAD) computers with the same capacity as the MINSK-32 will cost several times more ... until comprehensive measures are implemented to insure comparable prices, second generation computers must be used extensively." In fact, the ES-1030

* Possibly the MITRA-15, developed by Compagnie Internationale pour l'Informatique.
** At the official rate of exchange.

Table 3

USSR and Eastern Europe: Facilities for RYAD Production[1]

Country and Model	Facility/Location	Comments
USSR		
ES-1020	Brest Electrotechnical Plant/Brest	Possibly, several dozen units have been built. Apparently converted for computer production.
	Minsk Computer Plant (Ordzhonikidze)/Minsk	Development, testing, and prototype production. Full-scale production of RYADs has been delayed owing to continued production of MINSK-32s.
ES-1030	Yerevan Experimental Computer Plant/ Yerevan	Development, testing, and prototype production. May be preparing for production. This plant's previous production of NAIRI computers may have been shifted to the Baku Radio Plant.
ES-1050	Moscow Computer Plant/Moscow	Prototype production. Planning to fabricate five prototypes during 1973.
	Penza Computer Plant/Penza	Apparently preparing for production.
ES-1060	Unknown	Still in design phase. A prototype has not yet been produced.
Bulgaria		
ES-1020	ISOT/Sofia	A few models have been assembled using imported components.
Czechoslovakia		
ES-1020 A[2] (ZPA-6000/20)	ZPA/Cakovice	A prototype reportedly has been produced.
ES-1030 A[2] (ZPA-6000/30)	ZPA/Cakovice	Under design.
East Germany		
ES-1021[2] (ROBOTRON-21)	ROBOTRON/Dresden	Several units reportedly have been produced.
ES-1040	ROBOTRON/Dresden	Development, testing, and prototype production.
Hungary		
ES-1010	Videoton/ Szekesfehervar	Preparing for production. A few prototypes have been built.
Poland		
ES-1030	Elwro/Wroclaw	Development, testing, and prototype production.

1. Assembly of central processing units.
2. Modifications of RYAD models.

costs three times as much as the MINSK-32 (320,000 rubles); the ES-1020, which has roughly the same computing power as the MINSK-32, will cost an estimated 600,000 rubles, nearly twice as much.

24. In addition to a much higher initial purchase price, the RYAD, because of its complex hardware and software, will require the user to employ more people with higher skills. This means higher operating costs. At three times the initial cost and many times the operating cost, an ES-1030 would need to perform several times as much work as a MINSK-32 to be competitive. RYAD computers, which cost more to buy and maintain than MINSK-32s, will probably encounter "buyer resistance," especially from smaller facilities where the technical capabilities offered by the MINSK-32 are adequate.

Production Goals

25. No official plan for production of RYAD computers has been announced. The 1971-75 Plan provides only that the USSR will "put into series production new systems of electronic computers based on integrated circuits."

26. There is much evidence, however, that general objectives for RYAD production in 1971-75 do exist. After a prototype had been tested successfully in 1971, the Soviets began to talk optimistically. The Deputy Chairman of the State Planning Commission, M.Ye. Rakovsky, stated that 12,000 to 15,000 third-generation computers would be produced in 1971-75. The Soviet press reported that more than 10,000 third-generation computers would constitute the base of the automated systems of management to be set up.* Other sources said that the total number of computers of all types in use in the USSR would increase from 7,000 in 1970 to 25,000 in 1975 -- an increase possible only with large-scale production of RYAD or other third-generation

* Avtomatizirovannye Sistemy Upravleniya (ASUs). Several such systems have been developed by and for a few large plants. The heart of these systems is the "information-computer center" (Informatsionniy-Vychislitel'niy Tsentr -- IVT) which typically includes one or more computers for data processing.

computers or with massive imports.* Soviet computer industry officials also told a US consulting firm that the USSR would have 35,000 RYADs by 1980. Another aspect of the RYAD program calls for a huge training effort to provide skilled programmers, systems analysts, and technicians. During 1971-75, about 160,000 computer specialists will be trained, including 50,000 systems analysts. That number of trained specialists, based on US experience, would be sufficient to maintain about 15,000 RYAD systems.** Together, these statements suggest that the Soviets hoped to be producing 3,000-5,000 RYADs annually by 1975.

Cost of the RYAD Program

27. RYAD is a costly program in terms of both expenditures and manpower. The cost of developing RYAD (hardware and software) was estimated by Academician Dorodnitsyn in 1967 at 10 billion rubles ($13.8 billion),*** although the USSR's financial burden has been reduced to some extent by Eastern Europe's participation in the program. This cost is equivalent to that of building and equipping three plants the size of the Kama Truck Plant, the largest heavy truck plant in the world. In the United States, the counterpart IBM 360 program was developed at an estimated cost of $5 billion.

28. Although the RYAD program is large, the program's manpower requirements seem astonishingly high. According to Soviet sources 300,000 people are involved in the program in the USSR and Eastern Europe. By comparison, only about 172,000 people were employed in the entire US computer industry in 1972. RYAD's manpower requirements probably

* Besides the RYADs, the USSR is developing third-generation computers for process control in industry. That program, called Aggregatnaya Sistema Sredstv Vychislitel'noy Tekhniki (ASVT) centers on the M series of computers -- M-4000, M-5000, M-6000 -- now claimed to be in the early stages of production.

** In the United States, three programmers are needed at the user facility for each IBM 360 system, and one is needed at the plant for every three systems.

*** At the official rate of exchange.

will be cut back sharply when RYAD moves out of development and into large-scale production. In the United States a labor force of 25,000 could produce 3,000 small RYAD systems annually, including components (integrated circuits and memory cores) and all the peripherals needed for a standard configuration.

29. Although manpower needs may fall, the transition to large-scale production of RYADs will strain the production capacity of the Soviet computer industry. The estimated requirements for electronic components and peripherals to support an annual production of even 3,000 RYADs of the simplest type (ES-1020 and ES-1030) in a standard configuration are large relative to current Soviet capabilities. This situation may be seen in the accompanying tabulation.

	Required for 3,000 RYADS	Estimated 1972 Soviet Output
Integrated circuits (million units)	50-60	30-40
Ferrite memory cores (billion bits)	6	2
Magnetic disc units (thousand units)	10	Negligible

30. In addition, at least 2 million square feet of floorspace would be required to assemble the central processing units alone -- more than half of the estimated floorspace in the eight Soviet plants known to be major producers of these units. The largest computer assembly facility in the USSR, the Minsk Computer Plant, has about 500,000 square feet of floorspace, an amount sufficient to produce about 750 RYADs annually. To produce 3,000 ES-1020s per year, the USSR would need four plants the size of the Minsk Plant just to assemble central processing units; to produce 5,000 RYADs annually, the requirement for floorspace would be about two-thirds larger. Only two facilities -- the Minsk Computer Plant and the Brest Electrotechnical Plant -- have been associated definitely with the manufacture of central

processing units, and the main item of production at Minsk continues to be the MINSK-32. The Brest plant may become the major producer of the ES-1020; its size is unknown.

Progress and Problems

31. Reportedly, "several dozen" RYAD computers have been built in the USSR and a few have been installed in user facilities. Several more have been built in Eastern Europe. No RYAD model is being produced in large quantity, however, and the program as a whole is at least three years behind the schedule originally announced by Academician Dorodnitsyn.

32. The ES-1010 (the smallest variant) is being tested in Hungary, and according to the local press will go into production before the end of this year. By 1975, Hungary plans to manufacture 100 to 150 units a year. A prototype of the ES-1020 was fabricated by the USSR as early as 1970 and passed acceptance tests in 1971. The "first batch" reportedly was delivered to customers in early 1972 when series production was said to have begun. Subsequent information indicated that the ES-1020 was being redesigned at the Minsk Computer Plant, and in December 1972, Gosplan Chairman Baybakov implied that production would begin in 1973. Although this model was still undergoing acceptance testing by a small number of users in mid-1973, the ES-1020 probably is now in limited production.

33. In Eastern Europe, Bulgaria was the first to exhibit a prototype of the ES-1020 -- at the Plovdiv Fair in late 1971. Czechoslovakia claims to have built a successful prototype of its version of the ES-1020 (the ZPA-6000/20 intended mainly for internal use) and said that production might begin in 1973. East Germany's version of the ES-1020 (the ROBOTRON-21, also designed primarily for internal use) is behind schedule too, although a few units have been built and installed.

34. Little is known about production of the more advanced RYAD models. The ES-1030 has been "recommended" for production in the USSR, and Poland claims to have produced a working prototype.

Czechoslovakia's version of the ES-1030 is still in the design stage. East Germany may have built two experimental models of the ES-1040. The two largest RYADs, the ES-1050 and ES-1060, require special integrated circuits that are only in experimental production in the USSR.* The USSR has built a prototype ES-1050 and plans to produce five more experimental ES-1050s this year; the ES-1060 is still in the design phase.

35. The delay in the RYAD program is the result of a number of factors, especially a shortage of some critical components. The limited output of high-quality integrated circuits has been shared with other high-priority claimants, such as producers of military equipment and ASVT process control computers. There are also problems with the supply of peripheral equipment. Magnetic disc peripherals, needed for every RYAD installation, are still in short supply despite years of development. The USSR has found too that compatibility between computers and peripheral equipment requires close tolerances that are difficult to obtain. In this regard, the RYAD, like all Soviet computer projects, has been handicapped by a failure to apply automated production techniques or computerized on-line testing technology. Software development also has lagged. The RYAD program was supposed to capitalize on the software used in the IBM 360 series, but it has proved more difficult than expected to adapt IBM software or to modify the RYADs to handle the IBM software.

36. Above all, the RYAD program is suffering from the same lack of effective direction, coordination, and control that has plagued Soviet computer development over the years. A recent Pravda article deprecated the duplication in research and the misallocation of skilled labor resources among scattered institutes, ministries, and departments. Even so, no single authority, as far as is known, has been vested with responsibility to bring about the necessary coordination.

* These circuits are emitter-coupled logic (ECL) integrated circuits rather than transistor-transistor logic (TTL) devices to be used in all other models. ECL, which is significantly faster than TTL, is needed for the very high speeds required by the ES-1050 and ES-1060 models.

Western Assistance

37. The West has played a small but crucial role in the RYAD program. Early in the program a number of IBM 360 series machines were approved for export to Eastern Europe and hence became available for Soviet inspection. In addition, critical RYAD components are being manufactured with the help of production machinery acquired, both legally and illegally,* from firms in the United States, Western Europe, and Japan. To manufacture multilayer printed circuit boards, for example, the USSR purchased several dozen precision spray-etching machines,** mostly from the United States, valued at about $2 million, and an unknown number of lamination presses and numerically controlled drilling machines from the United Kingdom. The USSR also reportedly purchased two complete printed circuit manufacturing plants from France. The USSR now is interested in buying more advanced US technology and machinery for manufacturing printed circuit boards.

38. The COCOM embargo has hindered the USSR in its efforts to acquire technology and machinery to produce integrated circuits. Still, much US, British, Japanese, and French equipment has found its way to the Soviet Union and is being used to make integrated circuits in Soviet laboratories and plants. So far the USSR has been unable to buy complete plants to produce ICs, but inquiries in the West continue.

39. The USSR also has sought to purchase complete US plants to manufacture magnetic tape, magnetic disc packs,*** disc drives, magnetic cores, and printers -- all based on highly automated (computer-controlled) production and test techniques. Some equipment to manufacture disc drives has been acquired from Japan and France.

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* That is, outside established COCOM embargo channels.

** Chemical milling machines used to etch out electrical patterns of printed circuit boards.

*** A recent application by a US firm to export two separate plants to produce magnetic tape and disc packs, valued at nearly $50 million, was denied by the US Government.

Prospects

40. The likelihood that RYAD computers will be produced on a large scale by 1975 -- several thousand per year -- is poor. No new facilities for assembling RYAD central processing units are known to be under construction. Neither does the massive conversion of existing floorspace from the production of second-generation machines appear to be taking place. To the contrary, the Minsk Computer Plant, originally designed to produce RYADs, now is scheduled to continue to produce the obsolete MINSK-32 in 1973-75. Indeed, these machines are being improved, and output is scheduled to grow from 300 units in 1972 to 900 units in 1975. The MINSK-32 rather than RYAD, according to recent Soviet press statements, will serve as the basic machine in the automated systems of management being set up during 1973-75.

41. Even after 1975, mass production of RYAD computers will be difficult without substantial help from Western manufacturers. The USSR can be expected to press its efforts to acquire machines and technology for automated assembly of central processing units as well as other computer-related equipment and technology. The value of the production equipment and technology that the USSR might import over the next few years could range from $100 million to $200 million. The Soviets, however, are not likely to purchase many (several hundred) IBM computers; the Soviets have stated emphatically that they are firmly committed to RYAD and are not interested in large numbers of used computers.* Any machine imports will be restricted to high-priority needs for which Soviet computers clearly are not adequate. These purchases, however, will involve large expensive computers for use in complex applications and could result in sales of several hundred million dollars during the next three to four years.**

* At a recent press conference, D.M. Gvishiani, Deputy Chairman of the State Committee on Science and Technology, stated: "We are not interested simply in buying computers, even if credits are available."

** The USSR reportedly has signed a multimillion dollar contract with [footnote continued on p. 19]

The USSR would also purchase IBM 360 applications programs for use with RYADs if these could be obtained on a single-price no-royalty basis. Such programs would be especially useful in fostering increased industrial productivity.

42. The least complex RYAD models -- ES-1010, ES-1020, and ES-1030 -- will probably be produced on a small scale in Eastern Europe and the USSR in 1973-75. Small numbers of ES-1040s also may be produced by East Germany. All these machines are based on electronic circuit elements that already are in production. A few experimental production models of the ES-1050 will be built, although the most advanced RYAD machine -- the ES-1060 -- may not even reach the prototype stage.

43. The RYADs that are produced are likely to fall short of Western standards, just as the computers now in use do, despite the RYAD's reliance on IBM designs. The USSR lacks the newest technology for testing components, quality assurance techniques (including zero-defect and other standardized manufacturing procedures) are only now being adopted, and the labor force is less skilled than its Western counterparts. The operational effectiveness of RYAD computers probably will be further limited by shortages of external random access storage devices, display terminals, and high-speed data transmission equipment.

44. The crash program to increase the number of systems programmers is likely to fail. Most programmers are being trained in Soviet universities, many of which do not even have a computer and none have RYADs. In any case, 50,000 systems analysts cannot be trained adequately in universities on an accelerated basis. In the United States, several years of highly specialized post-university training sponsored by computer manufacturers is generally needed to reach professional standards. As in the past, trainees are to be "programmer-mathematicians." The mathematical training, which may have been useful for programming past Soviet computer systems,

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IBM for large computers to handle the scheduling and reservations for Intourist. IBM apparently has also been chosen to provide the computers for management and automation of the Kama Truck Plant.

takes time and is not needed for RYAD's high-level languages. Finally, to be fully effective, programmers need in-place training at the user facility -- training that the USSR does not generally provide.

45. When the RYAD program finally gets into high gear, it probably will keep the Soviet computer industry technologically inferior to those in the United States, Western Europe, and Japan. Soviet industrial practices will tend to freeze the RYAD design and prevent the modifications and improvements needed to stay abreast of changes in technology. In fact, the hardware and software technology embodied in the RYAD design is being superseded rapidly in the United States. IBM has introduced an advanced 370 series of computers that incorporate across-the-board hardware improvements and more efficient concepts of operating software.

46. Meanwhile, it may take some time for RYADs to be used efficiently. Technical manuals and other documentation are not yet available, making it difficult for the user to choose among the various RYAD models. In addition, because the programmers, systems analysts, and technicians are not being trained on RYADs, many users will have to rely on specialists who will have to learn as they go.