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Computers in Communist Countries: Production, Requirements and Technology

Summary

Among the Communist countries, only the USSR produces substantial numbers of electronic computers. Poland and East Germany each produce a few small computers, but, generally speaking, all the Eastern European Satellite countries depend on imports of computers from the USSR and the Free World. Communist China produces a few computers (mostly analog types) of obsolete design, and depends on imports for more advanced models.

Soviet computer technology has remained consistently five or more years behind the US. In the production of peripheral equipment necessary for effective use of computers in the role of automatic data processors, the USSR is deficient in both volume and assortment of output. Peripheral equipment designed for use with the newest Soviet computers has been much improved but is still inferior to Western models. Serious shortages are still evident in the supply of trained personnel for computer programming and maintenance.

The production of analog computers in the USSR is generally adequate, but the supply of digital computers, not established before 1955, is not sufficient for all Soviet needs (scientific, military/space, industrial, business data processing). During the Seven Year Plan, 1959-65, the production of computers achieved very high growth rates, on the order of 30 percent per year, but the value of production is still only about 10 percent of that of the US. Rapid rates of growth of computer production are expected to continue through 1970.

The bulk of Soviet computer production is allocated to military organizations and to institutes and factories with military-related tasks, and, until recently, there were few computers available to any but the highest priority civilian-oriented purposes. Greater attention is now being given to the production of computers designed for processing business data.

A. USSR

1. Organization of the Industry

Responsibility for the design and production of computers in the USSR is divided among several organizations.

Initially, research institutes under the control of the Academy of Sciences played the major role in the design of computers intended for serial production. This role naturally evolved from the work of such institutes on the design of the early scientific computers. In recent years computer

plants, employing their own research departments, have assumed some of the burden of computer design, particularly for computers that are essentially refined versions of those that the plants have been producing. Special purpose computers are frequently developed by the user. If sufficient demand exists for a special purpose computer, it will be assigned to a computer plant for production. An interdepartmental commission at the national level, composed of representation from design, production and user groups evaluates prototype computers and decides whether or not they shall be placed in production.

Most computer plants are subordinate to the Ministry of the Radio Industry, which sets their output levels. The production of process control computers, however, is the particular responsibility of the Ministry of Instrument Building, Means of Automation, and Control Systems, which, moreover, directs the application of this type of computer in some areas of the economy.

Although the USSR seems to have no lack of competent scientists and engineers for the design of computers, there are severe manpower shortages both for computer production, where the lack of skilled labor is evident in poor workmanship, and for computer servicing, such as installation, maintenance and programming. The shortcomings in maintenance and programming services result in poor utilization of existing computers.

2. Trends in Computer Production

The USSR was slow in introducing transistorized computers into production and accomplished this in the period 1961-62, compared with its accomplishment in 1958-59 in the US. To date, the USSR has disclosed no computers that use integrated circuits. Production of tube-type computers was not completely phased out until 1965, although all models brought into production since early 1964 have been transistorized.

Until recently, Soviet computers were designed primarily for solving the mathematical problems of science and engineering, and the peripheral equipment necessary for data processing applications was slow and unreliable, or non-existant. Since 1962, more attention has been given to the design and production of computers suitable for data processing. In 1965, the Soviets announced that five new, large, general purpose, transistorized computers (BESM-3, BESM-6, URAL-11, URAL-14, URAL-16), which had adequate memory size and peripheral equipment to serve as data processors, had been developed and were ready for production. It is expected that by the end of 1966 some of these machines will be produced at annual rates as high as 100 units per model (see Appendix B).

The rapid increase in production of computers during the course of the Seven Year Plan (production in 1965 was six times 1958; see Table 1), is believed to reflect, among other pressures, a recognized requirement for large amounts of data processing equipment. Production areas at major computer plants have been greatly expanded. It is expected that the high priority now accorded the production of computers will persist through 1970, and that the Soviet Union will employ computers ever more extensively for handling business and economic data.

Table 1

Estimated Soviet Production of Computers, [illegible]

	1958	1960	1963	1965	[illegible]
Value in Million Rubles	44	74	163	265	[illegible]
Index (1958 = 100)	100	168	370	602	[illegible]
Value in Million US $ **	33	56	122	199	[illegible]

Table 2

Estimated Quantity of Digital Computers Produced in the USSR, Selected Years

	Units		
	1958	1960	1965
Large	10	60	30
Medium	110	160	310
Small	60	130	[illegible]
	180	350	[illegible]

* This estimate does not include the production of [illegible] computers.

** Rubles were converted to dollars at the rate of 1 Ruble = [illegible]

3. Production Technology

Soviet production technology is characterized by wide variability in product quality between individual plants. With few exceptions, however, Soviet production methods result in computers of lower quality than those produced in the Free World.

Although Soviet computer plants have greatly expanded capacity during the recent plan period, they have not modernized their production techniques. US computer manufacturers visiting the USSR have commented that inefficient plant layout contributes to poor productivity and makes the changeover from one model to another very difficult. US plants of equal size can produce two or three times as much as those in the USSR. The Soviet plants are heavily labor intensive; advanced types of production equipment are almost completely lacking.

Quality control is not effectively administered in the production of Soviet computers. Even computers that have been in routine series production for a considerable time exhibit shoddy construction, poor manufacturing techniques, the substitution of makeshift components, and faulty parts in both the electronic and electromechanical components. As a result, a high percentage of the users' computer time is wasted in repairing the equipment. The deficiencies in quality do not seem to be related entirely to the complexity of the computers nor can they be excused as the normal problems of starting up production of new models. For example, the relatively simple memory units on recent examples of the series-produced URAL computers were poorly constructed and had a high failure rate.

The quality of Soviet computers suffers as much from deficient components as from poor assembly techniques. Many of the circuit elements presently in use in the USSR are of a type and quality abandoned by the US in 1958. The semiconductor elements employed by some Soviet producers, such as the Minsk Computer Plant, are of entertainment grade and may require 100 percent retesting by the computer plant. Some computer producers go so far as to redesign the equipment to minimize the bad side effects of the unsuitable components which must be used.

For certain computers, however, high quality components have been allocated. Yershov, of the Novosibirsk Computer Center, in a statement to a US computer expert, revealed the existence of the M-220 computer, which, although similar in design to the BESM-3, costs twice as much because it is fitted with high performance, military grade transistors. It seems likely that such high quality computers are produced for high priority users, and that the producing plants may have better production equipment and better quality control.

a. General Purpose Digital Computers

Soviet digital computers currently in production, such as the MINSK-22, employ transistors and other circuit elements similar to those used in the early US transistorized models. The plug-in circuit boards have printed circuits with the individual resistors, capacitors, transistors, etc., inserted and soldered by hand. The transistors, diodes, and other circuit elements are the same types that have been produced in the USSR for more than five years. Evidence that the Soviets are capable of a far more advanced component technology has been observed in Soviet publications and in highly miniaturized Soviet radios such as the MICRO, but this technology does not yet seem to be available for use in general purpose computers. Instead, it is estimated that the newly announced Soviet computers, whose series production is just now beginning, will incorporate improved forms of the semiconductor technology that has been employed in Soviet computers in the recent past. The improvement will consist of better quality transistors and diodes (higher frequencies, broader bands, lower power requirements, etc.), smaller circuit packages, improved circuit designs, and better fabrication techniques. Eventually, probably within three years, the USSR will produce general purpose computers with integrated circuits At present, commercially economic processes for the production of integrated circuits apparently have not advanced far enough to permit the use of these devices in computers, and it is unlikely that the USSR will achieve in its computers, the level of technological advancement represented by the IBM 360 series before 1970. The characteristics of some general purpose digital computers are given in Appendix B.

b. Special Purpose Computers

Since the early 1950's, the Soviets have emphasized the efficiency to be obtained by appropriate use of special purpose computers. In recent years individual plants have developed and used special purpose computers to meet their own needs, but it is only within the last few years that the USSR has revealed series production of specialized computers. Most of these are intended for industrial control and/or industrial production planning and scheduling. Of the dozen or so that have been mentioned in open publications, the most important are probably the Dnepr, UM-1-NKh, VNIIEM-1, VNIIEM-3, and UM-1. Along with their specialized computers, the Soviets also have developed and produced data loggers such as the MARS 100 and MARS 300 types and plant dispatching systems generally similar to those that have been used for the last ten years by Western industry.

The Dnepr, UM-1, and VNIIEM-3 models are intended both for use as control systems and as independent data processors. They have provisions

for on-line communications and analog to digital conversion. All are transistorized and the level of technology is similar to Free World models produced in 1960-61, such as the Honeywell 290, RW 300, and G.E. 312. The UM-1-NKh digital computer, is particularly interesting because of its small size (33 x 21 x 13 inches without power supply).

While they have developed a sizeable variety of specialized control computers, the Soviets are not known to have exported any digital control computers and production does not appear to be large enough to fill domestic demand. Continuing Soviet purchase from the Free World of control computers and complete systems incorporating computers indicates an inability to meet domestic industrial demands. (See Appendix A). Soviet knowledge of miniature digital differential analyzers and other specialized computers suited to military systems has been revealed in technical publications but no details on such devices have been given.

c. Analog Computers

Developmental work on analog computers began in the USSR shortly after World War II and by 1952 an adequate capacity for the production of analog computers had been established. Much of the best work on analog computers is associated with military needs such as surface-to-air missile systems. At the present time the main developmental work on analog computers is concentrated at research institutes that are known to be active in military and space activities.

The USSR produces a broad range of analog computers, including desk size and high precision types, and in 1960 displayed a technical competence generally similar to that of the US at that time. Present production is believed to be adequate for domestic needs, and several analog computers have been exported to the Eastern European Satellites, Communist China, and to selected Free World countries such as India. It is clear, however, that the USSR lags the Free World in the quantity and quality of peripheral equipment available for use with analog computers and in the use of transistorized computers. The Soviets are known to have at least three models of transistorized analog computers -- the MN-10, a small computer similar to the TR-10 produced by Electronic Associates in the US, and the large scale models, MN-17 and MN-18. No specific installations of transistorized analog computers have been revealed to date and it is assumed that such models are used in secure areas. Installations of high grade digital readout equipment, input/output equipment, and data plotters have not been observed. The characteristics of some Soviet analog computers are given in Appendix C.

4. Operation and Service

The present Soviet facilities for servicing and programming computers are inadequate. The USSR has extensive plans for expanding these service facilities, but the supply of trained personnel will not be sufficient

to support Soviet plans for the widespread installation of computers. Computer producers offer their customers limited instruction in programming and operating computers, but the level of competence acquired by user personnel is considerably below that expected by Western users. Soviet computer manufacturers do not offer service contracts: once the computer is installed and operating, the manufacturer takes no further responsibility for its maintenance. Spare parts are often unobtainable from the factory or other suppliers, and computer owners are forced to use their ingenuity to restore a "down" computer to operation. The user's makeshift repairs may change the characteristics of the computer so much that 'standard' programs cannot be run. An attempt is being made to rectify the shortage of skilled programmers and computer operators by initiating courses in the research institutes and the higher educational establishments , however the supply of trained personnel will continue to lag demand for several years.

5. Requirements for Computers

As much as three quarters of the USSR production of general purpose computers is believed to go to military-nuclear-space users.* Computers still remain in short supply for commercial applications. With the rapid increase in production in recent years, this situation has eased somewhat over that of four years ago when computers were allocated only to scientific research institutes on the basis of priority research projects.

If Free World export restrictions were removed, it is estimated that the USSR would make attempts to import some large scale systems and peripheral equipment, and/or to obtain licenses for the manufacture of peripheral equipment. Acquisition of advanced peripheral equipment from the Free World would tend to alleviate shortages in the interim while the USSR is accelerating production of domestic designs. The USSR probably would not purchase small and medium sized computer systems from the Free World, because domestic production is adequate to meet pressing demands. Advanced military and space systems, such as on board control systems, for missiles and space vehicles would of course be designed and produced in the USSR.

B. East European Satellites

1. Production and Level of Technology

The East European Satellites have been slow in developing their computer industries and must rely on imports from the USSR and the Free World to satisfy their needs. Poland, which is the major producer of computers among the Satellites, produces about 45 digital computers and somewhat fewer analog computers annually. Two models of small digital computers are in serial production: the ODRA, which is being sold throughout the Bloc, and the ZAM. Poland is just now initiating the production of transistorized computers, but because the domestic electronics industry is not able to supply transistors and diodes of the high quality necessary for fast reliable computers, these components must be imported.

* The USSR has made no secret of its wide application of computers throughout all branches of science and industry, and in fact seeks enhancement of its image as a modern computer- using state. A comparison of all known Soviet computer installations with the numbers of computers probably produced, leads to the conclusion that about three-fourths of computer production is employed on unpublicized tasks.

In the last three years, East Germany has produced about fifty units of its small digital computers, the ZRA, but its real forte lies in the production of office machines and calculators rather than in the production of digital or analog computers. Although East Germany has plans for expanding its computer industry somewhat, the emphasis will remain on office equipment and small electronic data processing machines rather than on large scale computer systems. The lack of high quality components, and the expense involved in establishing a development and production capability make it more economic for them to import larger systems.

Computer production in both Czechoslovakia and Hungary is almost nonexistant, despite their substantial electronic industries. Czechoslovakia is working on the design of several computers, but to date produces only a few analog and digital computers each year.

Rumania and Bulgaria have made several prototype models of digital and analog computers, but have no production capability and must rely on imports to satisfy their internal demands.

The European Satellite countries have a critical shortage of trained personnel with which to program and service existing computers. However, a major training program is under way.

2. Satisfaction of Requirements for Computers

Intra-Bloc trade in computers is very small. The USSR, which is the principal Bloc supplier of computers, exports only a few--on the order of 10 to 20 per year--to the other Bloc countries. In addition Poland, in 1965, sold two computers to the USSR and one or two each to Hungary, Czechoslovakia and East Germany. East Germany has sold a few ZRA machines to other Bloc countries. There is almost no exchange of technical information between the USSR and the European Satellites.

The European Satellites show a marked preference for Free World computers over those of the USSR. Free World countries offer better delivery dates, a ready supply of spare parts, and computers of superior reliability, performance, and ease of programming. The limiting factors to Satellite procurement of Western computers are scarce reserves of foreign exchange and COCOM restrictions. Despite this, the EuSats have invested heavily in Western computers in the last five years (see Appendix A) and have indicated intentions of doing so in the future.

It is estimated that the annual Satellite import market for computers will be in the range of US $10 to 20 million during the next five years. The bulk of this demand will be for small and medium sized digital computers having extensive peripheral equipment appropriate for data processing.

The largest importers probably will be Czechoslovakia and East Germany, each of which may have import markets as large as US $3 million per year. The EuSats almost universally have indicated a desire to obtain Western licenses to manufacture computer components (especially high quality, high performance transistors) and peripheral equipment such as magnetic tape transports. They also would like credits for periods up to eight years, the right to visit manufacturing plants in the West, and foreign training for their computer technicians. These requests reflect the major problems in production and utilization of computers in the European Satellites.

The EuSats have indicated that they will use imported computers for routine data processing applications such as inventory control in industry, banking, government statistical offices, and marketing and production planning.

C. Communist China

The Communist Chinese computer industry continues to engage in the study, assimilation, and adaptation of foreign work. While much of their work has been based on Soviet results, particularly the early Soviet work, since the early 1950's the Communist Chinese have carried on a world wide surveillance of technology. Their heavy emphasis on adaptation of foreign results makes it extremely difficult to distinguish the level of native competence represented in many of their developmental and production results.

The first Chicom analog computer was developed in 1956, and by 1959 about 40 different models had been constructed. These were all small and all probably were based on widely available published Soviet and Western results. Some analog computers also were imported. Although public announcements of new models were rare between 1959 and 1965, developments continued, with the Institute of Automation in Peking displaying the most competent work on functional devices.

During 1965, at least four models of analog computers were in series production. Two models, the FM-8 and an unnamed 24 amplifier model are produced by the Tientsin Electronics Instruments plants. The Peiping Radio Plant No. 1 is producing an unnamed 20 amplifier model, and a model called the DMJ 16, which was displayed at Paris, is being produced at an unidentified facility. All of these are small vacuum tube types that appear generally comparable to small US and Soviet models of about 1955-1956, although none appears to be direct copies of any other model. While information is insufficient for estimating the number produced, it is clear that production facilities that have been identified could build analog equipment for use in military defensive systems similar to early versions of Soviet and US surface-to-air missile systems.

As in the case of analog computers, all known domestically constructed Communist Chinese digital computers are vacuum tube types. Work on transistorized models has been claimed but inadequate supplies of high quality

components probably hampers such work. Soviet influence has been very heavy and all known domestic models were constructed from Soviet designs. The most advanced computers in use in Communist China today were imported from Great Britain and France. The British companies, English Electric, Elliott Brothers, and International Computers and Tabulators have been very active in dealings with the Communist Chinese, exporting models such as English Electric KDF 9 which were first installed in Great Britain in 1963.

The leading facility for work on digital computers is the Institute of Computation Techniques of the Academy of Sciences in Peiping. Working with the Peiping Wire Communications Plant, this Institute has constructed three models. The first was the Model 103 (also called Pa-i), copied from Soviet M-3. Several Model 103 computers were constructed by the Institute of Computation Techniques and it now may be in production by the Peiping Wire Communications Plant under the designation DJS 1. The second model was the Model 104, a copy of the Soviet BESM-2, which now may be in production currently under the designation DJS 2. Possible production of these models by the Peiping Wire Communications Plant was indicated by a 1965 newspaper advertisement for DJS 1 and DJS 2 model computers. Most recently the Institute of Computation Techniques has completed a model called the 119 that appears to have been based on the Soviet M-20. The Institute of Computation Techniques in Shanghai also constructed a copy of the Soviet M-20 model. Major efforts on computers have been concentrated in Peiping and Shanghai, but engineering schools in other localities also constructed copies of the Soviet M-2 a few years ago.

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APPENDIX A

Bloc Imports of Western Computers

Estimated Date Shipped	Equipment	Destination
1963	NCR-315 (US) (2 Anelex line printers)	Poland, Warsaw Narodowy Bank Palski
1962	Perkin-Elmer 194 (US) Analog	Poland, PIHZ, Varimex
1966	ICT-1301	Poland, Warsaw, Institute for Management Training
1959-60	Short (US) Analog	Poland, Warsaw, Academy of Sciences, Electrotechnical Institute
1961	NE-803B	Poland, Warsaw, Electrotechnical Institute
	GEIR-1 (Denmark)	Poland, Warsaw, University of Warsaw
1964	BULL-300 (France)	Poland, Warsaw, State Railroad, Central Office for Mechanization and Automation of Statistical Accounting
1962-63	NE-803B	Poland, Warsaw, Construction Materials Center
1964	GEIR (Denmark)	Poland, Warsaw, Institute of Solid State Physics
1963	NE-803B	Poland, Gdansk, Shipbuilding Co., Central Design Bureau
1960-61	TY-864 Analog	Poland, Gdansk, Institute for Flow Machines

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GROUP 1
Excluded from automatic downgrading and declassification

Bloc Imports of Western Computers (continued)

Estimated Date Shipped	Equipment	Destination
1962	BULL-GAMMA 30 (France)	Poland, Katowice, Central Clearing House of the Coal Industry
1964	Small Analog /	Poland, Katowice, unidentified location
1960	Space-30 / / Analog	Poland, Swierk, Nuclear Research Center
1965	GEIR (Denmark)	Poland, Swierk, Nuclear Research Center
1962 (1965)	NE-803B (UK) (2 magnetic tape handlers)	Poland, Wroclaw, University of Wroclaw
1965	UNIVAC-1005-II-10	Czechoslovakia, unidentified location
	(4) UNIVAC-1004 (US)	Czechoslovakia, unidentified location
1965-66	Regnecentralen (Denmark)	Czechoslovakia, Atomic Research Center
1961	NE-803B NE-503 Extra l/ equipment Regnecentralen-3000 (Denmark)	Czechoslovakia, Prague Kancelarske Stroje
On order 1965	ICT-1905 Z-25/37 Extra drum	Czechoslovakia, Prague, CKD Engineering Works
1966	EELM LEO-360	Czechoslovakia, Prague, Transport Research Institute

Bloc Imports of Western Computers (continued)

Estimated Date Shipped	Equipment	Destination
	LGP-30 (US)	Czechoslovakia, Prague, Institute of Technology
1964	BULL-GAMMA 30 (France) (= RCA-301)	Czechoslovakia, Prague, Central Statistical Office
	NE-803A	Czechoslovakia, Prague, NII Technology, and Economics of Chemical Industry
	NE-803B	
1961	NE-803B (Formerly at Kancelarske Stroje)	Czechoslovakia, Prague, Statni Energeticky Dispecink
1960	NE-803B (Formerly at Kancelarske Stroje) UNIVAC-120 (US)	Czechoslovakia, Prague, SKODA Works
1962	NE-803B	Czechoslovakia, Prague, TROL Center
1962	SIRIUS	Czechoslovakia, Prague, Institute of Ferrous Metallurgy
1961	Z-23/01 Z-11	Czechoslovakia, Prague, Thermotechnology State
	Z-23/24	Czechoslovakia, Prague, Mechanical Construction Workshop
1965-66	NE-315 (NCR-315) 3 tape units 4 CRAM units	Czechoslovakia, Prague, Czechoslovak State Bank
	LGP-30 (US)	Czechoslovakia, Brno, Technical University
	LGP-30 (US)	Czechoslovakia, Bratislava, Ministry of Construction

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Bloc Imports of Western Computers (continued)

Estimated Date Shipped	Equipment	Destination
1963	ARCH-8000 (= NE-803B + NCR-315) 5 CRAM units	Czechoslovakia, Bratislava, Slavneff Oil Refinery
	LGP-30 (US)	Czechoslovakia, Kosice, East Slovak Steel Works
On order	ERMA/IBM-360 KDF-7	Czechoslovakia, Ostrava-Kuncice, Klemento Gohwald Ironworks
1963	Z-23/55 Z-23/62 UNIVAC- UNIVAC-80 Codetron	Czechoslovakia, Ostrava, Karvina Coal Field
1963	NE-803A	Czechoslovakia, Plsen, Lenin Works
	Z-11	Czechoslovakia, Dobruska, Military Topography Institute
	Z-11	Czechoslovakia, Prevor, Meopta Optical and Precision Instrument Plant
1960-61	Z-22	Czechoslovakia, unknown location
1962	Z-ZM	Czechoslovakia, Meopta-Prevor; Optical Factory
	BULL-GAMMA-30 (France)	Czechoslovakia, unknown location
1962	Amalog	Hungary, unknown location
1960	Z-22	Hungary, Budapest, Technical University
1962-63	NE-803P	Hungary, Budapest, Ministry of Metallurgy & Machine Building

Bloc Imports of Western Computers (continued)

Estimated Date Shipped	Equipment	Destination
On order	NCR-315	Hungary, unknown location
1963	BULL-TAMBOUR (France)	Hungary, Budapest, Hungarian State Railroads
1965	GEIR (Denmark) 4 Ampex tape units	Hungary, Budapest, Central Statistical Office
1962-63	(2) UNIVAC-1004 (US) BULL-GAMMA (France)	
1962	NE-803B	Hungary, Budapest, Ministry of Heavy Industry, Institute of Industrial Economy and Business Organization
1964	(2) NE-803	Hungary, Budapest, State Bank
1963	UNIVAC-80 (US)	Hungary, Budapest, Ministry of Traffic and Posts
1963-64	TRW-330 (US)	Hungary, to be incorporated into a chemical plant
1962	NE-803B	Hungary, unknown location steel plant
	IBM-1410 (US)	East Germany, Karl Marx Stadt, (Chemnitz)
1965-66	Solartron data logger	East Germany, Frankfurt-on-Oder, Transistor Factory
1965	NE-503	East Germany, Dresden
1965	(10) BULL-GAMMA-10 (France)	University of Dresden
1964	LGP-21 (US)	East Germany, Schwedt-Oder Refinery

Bloc Imports of Western Computers (continued)

Estimated Date Shipped	Equipment	Destination
1964	NCR-315 (US)	East Germany, Leipzig, Mail Order House
1965	SIEMENS HALSKE-3003	East Germany, Leipzig, Warehouse, Vereinigung Volkseigener
1963	BULL GAMMA-3 (France)	East Germany, State Planning Commission
1964	SIEMENS HALSKE-3003	East Germany, unknown location
On order	ME-803	Bulgaria, Sofia, NCR, Ltd.
1965	BULL GAMMA-30 (France) (RCA-301) (US)	Bulgaria, Central Statistical Work Bureau
In negotiation	(20) FUJITSU 230-20	Bulgaria, Kolkhoz System
1965	BULL GAMMA-3 (France)	Rumania, Bucharest, Central Statistical Board
1963	ARCH-8000 (ME-803 + NCR-315)	Rumania, Bucharest, Steel Mill
1962	ME-803	Rumania, unknown location, Chemical Processing
On order	NCR-315 (US)	Rumania, unknown location

USSR Installations of Western Computers

Estimated Date Shipped	Equipment	Destination
1964	NE-503	USSR, Moscow, Academy of Sciences
1959	NE-802	USSR, unidentified location
1960	NE-803	USSR, Moscow, Central Scientific Research Institute for Complex Automation
1962 1963	NE-803 NE-803	USSR, Moscow, Moscow Sovnarkhoz
1965	ZUSE 25/35	USSR, Novolipetsk Steelworks
1961	ARCH-8000 ((= NE-803 + NCR-315)	USSR, Voronezh, Chemical Plant
On order 1966	ARCH-8000	USSR, unidentified Ammonia Plant
On order	ARCH-8000	USSR, unidentified Ammonia Plant
1964	ARCH-1000	USSR, unidentified plant
On order	ARCH- ?	USSR, Natural Gas Fractionating Plant
1963-64	TRW-330 (US)	USSR, to be incorporated into a chemical plant before it is shipped
1964	ARCH-1000	USSR, Moscow, Industrial Research Institute
	JOHNIAC	USSR, unidentified location
On order	MARS-101 Seat Reservation System	USSR, Transportation Ministry