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SIGNIFICANCE OF SOVIET ACQUISITION OF WESTERN TECHNOLOGY

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Soviet Expectations from Western Technology

The declining productivity of capital and the very slow growth of labor productivity have reduced economic gorwth to levels which the Soviet leadership considers too low. To help spur technical progress the Soviets are importing Western technology and equipment and concluding technical cooperation agreements with Western firms and governments. Soviet leaders believe that importing foreign technology will provide production capacity in a much shorter time, and at less expense than it would take to develop the technology in the domestic applied R&D sector.

The Soviets have had numerous disappointments with Western technology and equipment. Machinery from Western firms has frequently failed to mesh well with existing Soviet equipment, with other foreign equipment, or with Soviet inputs into a production process. In part, this interface problems is a natural one. The Soviet applied R&D sector, however, takes an inordinate length of time to solve problems of compatibility within the civilian economy. The Kama Truck Plant is being furnished with the most modern equipment, but the interface problem is being complicated by Soviet bureaucratic inefficiencies and secrecy, and completion of the complex will be delayed by several years. For much the same reasons, the Fiat-equipped plant at Tol'yatti became operational 2 years behind schedule. A color TV plant, bought in 1968 is operating at only a fraction of its rated capacity in part because of improper operating procedures and poor maintenance. There are many other examples.

With all these problems, the Soviets believe that imports of Western equipment and technology have made, are making, and will make important contributions to the level of their technology and are therefore willing to pay substantial sums of foreign exchange to acquire Western equipment and technology. The Fiat plant has expanded automobile production substantially and in less time than the Soviets themselves could have done it. The rapid expansion of Soviet production of intermediate products for plastics and synthetic fibers could not have been accomplished without Western technology and equipment. It is estimated that Western equipment to produce ammonia ordered since 1969 will furnish at least half of the increase in annual output of ammonia during 1971-75 and perhaps two-thirds of the increase to be achieved in 1976-80.

Soviet imports of foreign technology have enabled the Soviets to upgrade the technological levels of the motor vehicle and chemical industries as well as other sectors. Moscow is acquiring invaluable know-how and experience for its engineers and technicians trained to use Western equipment and processes. Based on such experience and on licenses acquired from the West, the Soviets are able to develop their own designs and processes. Soviet imports of foreign technology probably will also raise technological levels in key areas such as computers, electronics and oilfield exploration, among others.

What is most important is that the Soviet R&D establishment itself cannot provide the equipment, technology, and know-how that the leadership believes is required to achieve planned goals. There is thus no real alternative to Western suppliers. The proof of this is in the value of contracts concluded with Western suppliers in recent years. Known Soviet orders for Western plant and equipment have increased from $1.6 billion in 1972 to more than $4 billion in 1974. Moreover, billions of dollars worth of Western equipment and technology are now being negotiated for purchase during the next five-year plan featuring equipment for the metallurgical and petrochemical industries, oil and gas exploration, transmission and refining, earthmoving equipment, nuclear power plants and others.

The Soviets are also continuing to sign technical cooperation agreements with Western firms. They have concluded more than 30 with US firms alone suggesting that the number of agreements with firms in the entire developed West is well over a hundred. Such agreements generally fall in areas of technology in which the Soviets are most interested -- computers, semiconductors, chemicals, oil and gas, etc. Moreover, the Soviets have concluded agreements covering the same technology with several firms -- a redundancy designed to maximize the acquisition of information and know-how.

#2 a (1) Illegal Negotiations and Trade

In view of the extensive Soviet efforts to acquire Western technology and equipment through a variety of channels and means, reported cases of trade diversion apparently represent the tip of a very large iceberg. Some idea of how extensive and organized Soviet efforts are to obtain Western technology, including controlled military and industrial technology can be gained by looking at Soviet institutional arrangements for accomplishing this task (attachment).

Some Examples

Intelligence reports document some attempts to purchase and the illegal shipment of embargoed items by various methods to the Communist countries:

The illegal purchase of embargoed items from witting middlemen at blackmarket prices has served as an important means of undermining existing trade controls. In the past year, the Soviets are known to have illegally purchased a weapons-oriented mini-computer and a David Mann pattern

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generator (semiconductor manufacturing equipment) from European businessmen. In both cases the incident went undetected and/or unreported by the exporting country.

On several occasions embargoed commodities have been illegally shipped to the Communist countries under false documentation. Recent intelligence has uncovered the unauthorized export [redacted] of embargoed semiconductor test equipment to the USSR and the PRC. Discussions are presently underway between this firm and Bulgaria for the sale of technology to produce this equipment. There are also indications that [redacted] firms exported metal-oxide semicondu--- (MOS), integrated circuit production technology and a [redacted] computer to the USSR without COCOM clearance. In none of these cases has any punitive action been taken b[redacted]

In response to a US confrontation in November 1974, Assistant Secretary Dimov of the Yugoslav Chamber of the Economy confirmed the diversion of US manufactured automatic computer memory core testers and semiconductor manufacturing equipment by a Yugoslav import-export firm to the USSR. Similar confirmation has also been forthcoming on the diversion of embargoed equipment to other Communist countries. It is uncertain whether there have been cases of trade diversion which were not admitted to by the Yugoslavs.

items of only limited assistance to strategic-military production.

Enforcement and Attitude

The multilateral controls arrangement (COCOM) lacks adequate enforcement machinery; participating countries have never agreed to any administrative system for policing or imposing sanctions. In recent years companies

ave exported important COCOM-embargoed technology and equipment without the approval of COCOM, and in certain cases these exports have been made with government approval. US unilateral controls also have been frustrated because the US has been unable to exercise effective extraterritorial control over subsidiaries and licensees. End-use assurances, destination checks, and other US enforcement procedures have not eliminated the diversion or transshipment of US-origin goods.

Diversions and illegal trade would take place even if other COCOM countries exercised as great a degree of control and enforcement as the United States. But such trade is facilitated by a more lax attitude of both government and businessmen in most of these countries vis-à-vis trade with the USSR and other Communist countries. These countries, moreover, exercise no special control over the export of technology to Communist destinations. They are more concerned

There are also strong indications that citizens of COCOM countries have been establishing firms in non-COCOM countries which manufacture and/or sell embargoed items in order to circumvent existing trade controls. As an example, Helmus Sieir, [illegible] as been producing semiconductor manufacturing equipment based on Western technology in Switzerland and exporting it to the Communist countries. [illegible] January 1975, the West German Government formally charged the head of a West German firm with illegally exporting computer hardware and software to the USSR through an Austrian-based firm. He had been denied US export privileges since 1970 for similar charges. Intelligence reports also indicate that the vice-president of an electronics firm in Vienna, Austria, has been purchasing US semiconductor manufacturing equipment for assembly and export to the USSR and the PRC.

The ease with which the USSR can acquire embargoed items illegally varies greatly with the size of items and their value. For example, significant quantities of integrated circuits are believed to be finding their way to the USSR and other Communist countries relatively easily, while larger items may be obtainable only in small quantities and at considerable expense. The relatively limited quantities and the unreliability of the supply sources tend to render such visiting the Soviet Union as vehicles for obtaining trade secrets and follow-up leads to US business firms. Longer-term clandestine activities involve the spotting, assessment and eventual recruitment of US businessmen as agents for the Soviet Union. In this last connection, it is not surprising to find that a large percentage of the staff of the USSR Chamber of Trade and Industry are KGB officers of wide experience.

with export promotion and many of them regard the sale of technology very much the same way as export of products.

[illegible] firms as well as governments tend not to be concerned with future competition resulting from the sale of most technology and more concerned with short-term gains. Those technologies that are protected by the firms are guarded just as zealously against acquisition by non-Communist firms as by Communist countries.

Soviet Clandestine Acquisition of Foreign Technology

The bulk of Soviet foreign technology is obtained through overt mechanisms of foreign trade, licensing, scientific exchanges, and other means. The responsibility for gaining access to the restricted hard core of foreign military and industrial technology belongs to the intelligence services. The Committee of State Security, or KGB, through its Scientific and Technical Directorate, collects, on a worldwide basis, information on the most recent developments in key military technologies and in a very wide range of industrial processes. The military intelligence arm of the intelligence services, the GRU, the other major clandestine collection agency has functioned since the early 1960s in the shadow of the KGB. The latter is thus the mainspring of the Soviet clandestine collection effort. The intelligence services of the Eastern European countries are available to the KGB for the collection of foreign technology.

Two organizations serve as focal points for the generation of collection requirements, the State Committee for Science and Technology (GKNT) and the Military Industrial Commission (VPK). The former is responsible for coordinating the allocation of resources to civilian research and development and the latter for coordination of the efforts of defense industry, including its research sector.

One of the primary functions of the GKNT is to serve as a clearinghouse for requirements for foreign scientific and technical information submitted by the various Soviet non-military scientific and industrial organizations. With the assistance of KGB and GRU officers on its staff, the GKNT determines which requirements can be satisfied by overt methods, and which can be answered only by the intelligence services. Also with the aid of intelligence officers stationed within its foreign department, the GKNT prepares the annual plans for Soviet participation in scientific conferences, and for the exchanges of scientific and technical delegations which take place within the framework of cultural exchange agreements.

The VPK, presumably, after a similar screening exercise with its KGB and GRU representatives, levies defense industry requirements on the intelligence services. It is assumed that the KGB's Scientific and Technical Directorate serves as the coordinator of this phase of foreign technology collection as well, and that there is liaison between the VPK and the GKNT to avoid duplication of collection efforts.

While much Soviet civilian technology intelligence activity merely piggybacks industrial negotiations, Soviet intelligence makes full use of exchange students and technicians visiting the United States as well as exploiting American scientists

#2E. Trade Activities in Technology

In its efforts to obtain foreign technology and equipment, the USSR has increased its purchases in the West substantially. Soviet orders for Western equipment rose from $1.6 billion in 1972 to $4.1 billion in 1974. In addition, Moscow ordered $2.6 billion in large-diameter pipe for natural gas transmission in 1974. Soviet orders for equipment in 1974 were concentrated in the fields of chemicals and petrolchemicals, mining and construction, oil and gas, and motor vehicle manufacturing. Orders for Western electronics also increased considerably in 1974. West Germany, France, Japan and the United States are the main suppliers of machinery and equipment to the USSR.

In 1975-80 Moscow will probably continue to depend heavily on the West for technology and equipment. Based on current negotiations and estimates of import capacity, Soviet equipment purchases may reach an average of $5 billion annually in the next five years.

ırrent negotiations and general agreements already reached indicate that the Soviets will be importing equipment for an iron ore reduction complex from West Germany; chemical plants from Italy; an aluminum complex from France, and for timber, coal, and oil projects from Japan. rrent negotiations also suggest that the USSR will rely heavily on the West in other areas: the building of a second gas pipeline from the Orenburg fields; a major paper/pulp complex in Siberia; an oil refinery in the Soviet Far East; the BAM railroad, and a number of hotels. Moscow may also turn to the West for wide-bodied aircraft, complete plants for consumer goods, food processing plants, nuclear power plants, and other plants, equipment and technology. Finally, the signing of agreements to develop Siberian gas reserves, specifically the North Star and Yakutsk projects, could require $7 billion in Western equipment.

The chief constraints on Soviet imports of Western equipment and technology are Western export controls on certain multiple-use (as well as strategic) equipment and technology; Soviet import capacity, and Soviet ability to assimilate advanced Western technology. Export controls have been relaxed in recent years and only the most sophisticated technology and equipment are now denied to the Soviets, e.g., very powerful computers, semiconductor production equipment, and similar items largely in the electronics category. It is assumed that Western controls will be further relaxed at the current COCOM List Review, and export controls will be even less of a constraining factor in the future.

Until 1974 Soviet import capacity was an important constraint. Increased Soviet imports of Western capital goods led to an increase in debt to the West because of Soviet inability to generate sufficient export earnings to keep pace with import demand. But the sharp rise in prices for oil, raw materials and gold in 1973 and 1974 has substantially increased Soviet export capability and consequently import capacity.

Assimilation of Western equipment and technology continues to be a problem area for the USSR, but over time may ease somewhat as Soviet engineers and technicians gain experience with Western equipment. Much will depend on how the Soviets deal with the problems that currently inhibit the diffusion and use of both domestic and foreign technology.

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#2b (5) Impact of Technology Transfer on Soviet Economy

Soviet imports of Western plant and machinery through 1980 are not expected to provide dramatic boosts to the economic growth rate. First, the volume of machinery imports will be small relative to total domestic investment in the USSR. Even if machinery and equipment imports grow to the estimated $5 billion per year during 1975-80 and all are directed to industry, the growth of industrial investment will increase by only about one-half of one percent per year. Moreover, the ultimate impact on economic growth depends upon the use to which the resources freed by Western imports is put. These resources could be allocated to investment, defense, or consumption. Based on Moscow's announced policy to pay more attention to the consumer, a substantial share of the additional resources will probably be used to produce consumer goods, reducing the effect on economic growth.

Nevertheless, the technology transfer should help overcome bottlenecks now threatening future growth. Siberian development, for example, is essential for maintaining an adequate flow of raw materials to industry. The Soviets have admitted that Western technology and equipment are needed for petroleum exploration and drilling, particularly in permafrost areas and offshore. The lack of this equipment is contributing to the current slow rate of discovery which could result in declining oil production in 1979-82. The Soviets are also becoming increasingly dependent upon Western equipment -- pipe, compressors, and valves -- for extracting and delivering natural gas.

The acquisition of Western technology could also break the production bottleneck in the computer and semiconductor industries and allow a more concentrated use of native R&D resources. The introduction of modern computers, peripheral equipment and know-how would be felt throughout the economy, both in civilian and military sectors. Soviet access to a reliable supply of Western semiconductors could speed Soviet development of complex electronic systems and instrumentation for advanced weapons.

Western technology should also contribute to raising living standards, avowed by the leadership to be the primary goal of the current five-year plan (1971-75). The Soviet program to expand and modernize the automobile and truck industry has included purchases of about $2 billion of Western machinery and equipment. The large amount of fertilizer equipment and plants bought from the West will also benefit the consumer by increasing grain supplies in support of Brezhnev's livestock program.

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#2b (6) Impact of Technology Transfer on Increasing Soviet Dependence on the West

In aggregative terms, Soviet dependence on the West is insignificant. In trade with the West Soviet exports (or imports) currently represent little more than 1% of GNP. If imports increased, say, 15% annually over the next five years and GNP grew at about 5% (about the same as in the last five years), the share would still be less than 2% in the trillion dollar Soviet economy of 1980.

But Soviet trade with the West is very spécialized. Imports, particularly of capital goods, have been of considerable importance to those sectors of the economy which the Soviets have made great efforts to upgrade technologically, e.g., the chemical and petrochemical industries and the motor vehicle manufacturing sector. Such imports, together with imports of Western grain and other goods, have increased the importance of the West in Soviet foreign trade. Looked at in the perspective of two decades, continuing Soviet efforts to obtain Western equipment, technology and other products are, in fact, leading the USSR to a greater dependence on the West. The West now accounts for 31% of Soviet foreign trade, up from 15% some 20 years ago.

Although it is doubtful that the Soviets will subscribe to the idea of a so-called international division of labor for many years to come -- they have even resisted it for themselves in CEMA -- the kinds of transactions it is becoming more involved in may very well increase Soviet dependence on the West. For example, in the gas-for-pipe deals with firms in Western Europe, the USSR has agreed to deliver natural gas for periods of 20-30 years. Long-term Soviet supply commitments to the West [are] also involve aluminum, wood, and chemicals. The same type of arrangements apply to the proposed multibillion dollar projects calling for US and Japanese development of Soviet fossil fuel resources.

The traditional Soviet policy goal of self-sufficiency is dead even if it has not been given a decent burial. This does not mean that the Soviets are now ready to espouse the principle of comparative advantage. What it does mean is that without imports of Western equipment, technology, and capital the Soviet leadership is aware that its plans for upgrading Soviet industry and exploiting untapped Siberian resources would stand little chance of being fulfilled for many years to come.

Soviet orders are expected to be heavily concentrated in a few sectors, however, and may prove a major stimulus to manufacturers of chemical equipment, large-diameter steel pipe, and heavy construction equipment. For example, much of Europe's production of large-diameter steel pipe in the rest of the 1970s is earmarked for Soviet oil and gas lines; Mannesmann of West Germany is building a special plant to fill Soviet pipe orders. Several other large European firms, including Krupp of West Germany and Creusot-Loire of France, sell more than 10% of their output to the Soviets.

It is also unlikely that Western Europe and Japan will become dependent upon the USSR for supplies of raw materials during 1975-80. Although natural gas deliveries to Western Europe will increase rapidly -- to 22 billion cubic meters or more annually by 1980 -- Soviet supplies will still account for less than 10% of the total projected consumption of natural gas by the EC at the end of this decade. Soviet deliveries of coal and timber to Japan will increase substantially, but will also represent only a small share of total Japanese imports of these raw materials in 1980.

#3b. Problems in Assimilating Foreign Technology

Machinery purchased from Western firms frequently fails to mesh well with existing Soviet equipment, with other foreign equipment or with Soviet inputs into a production process. In part, this interface problem is a natural one. The Soviet applied R&D sector, however, takes an inordinate length of time to solve problems of compatibility within the civilian economy. In the case of the mammoth Kama Truck Plant, Western engineers and managers estimate that several years will be necessary to interface all of the foreign equipment into an integrated operation. The USSR is making integration even more difficult by limiting Western suppliers' visits to the site and by withholding from them useful drawings of the existing buildings in which the foreign equipment is to be installed.

Another Soviet policy that makes assimilation slow and difficult is the importing of equipment that is too advanced for rapid assimilation given existing levels of Soviet technological development. This overreaching is especially evident in the computer field. Color TV production provides another example. In 1968, the USSR purchased from a US firm a complete package of very advanced, automated machinery and technology for the fabrication of shadow masks for color television tubes. By the end of 1971, despite a year's training in the US for Soviet technicians, the equipment still was not operational and in fact had suffered severe damage through improper operating procedures and poor maintenance. Thus, the Soviets were forced to procure additional technical assistance and parts to restore the line to its original condition at a cost greater than the original purchase price. This line is now operating at only a fraction of its rated capacity and is a major bottleneck in Soviet production of color TV. The USSR has now decided on turnkey purchases from the US of equipment and technology to achieve large-scale production of color TV tubes.

Soviet assimilation of foreign technology also has been hampered by the low quality of the labor force which often fails to master unfamiliar and complex foreign machinery. The FIAT-equipped passenger car plant at Tol'yatti became operational about 2 years behind schedule. Labor problems were a major factor in the delay. Soviet workers frequently shut down an entire line to make minor adjustments to a single piece of machinery. Supervisory personnel at the working level, reluctant to make even minor decisions, bucked upstairs virtually all problem-solving decisions. Despite intensive training in Italy, technicians commonly reassembled machines improperly after repairs. Furthermore, in the FIAT plant as in other foreign installations, workers were casual in their approach to maintenance of precision machinery.

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In the case of the CDC 6200 computer at the Joint Institute of Nuclear Research in Dubna, reliability problems are serious because technicians will not conduct routine testing of electronic equipment -- an important factor in preventive maintenance. Part of the problem is the Soviets' lack of experience with computers prior to acquisition of the CDC 6200.

The management problems in the USSR that inhibit the diffusion and utilization of domestic technology also work against assimilation of foreign technology. Soviet enterprise managers are still rewarded primarily for fulfilling output plans and are unwilling to interrupt production to install new equipment, foreign or domestic. Management in the applied R&D system is also rewarded for fulfilling plans and not for developing usable technology or facilitating the wide dissemination of technology. The Soviet economy, in short, offers little incentive to upgrade technology or means for effectively diffusing technology to all potential users. Soviet management also lacks the experience and ability to plan and oversee the construction and start-up of huge, Western equipped factories. The Kama Truck Plant is the first, large-scale Soviet attempt to act as prime contractor for a large, Western equipped factory. Plans to build another truck factory in Siberia are evidently being held in abeyance while Kama's success or failure is assessed.

#2b (7) Impact of Technology Transfer on Increasing ~~Soviet~~ Dependence of Europe and Japan on the Soviets

The USSR as a market or a supplier traditionally has been or marginal importance to the major Soviet trading partners in the West -- West Germany, France, Italy, the Uk, Japan and the United States. The share of the USSR in the exports or imports of any of these countries is less than 2% and some cases even less than 1%. In terms of the dependence of these countries on the Soviet market for machinery and equipment, the percentages are not substantially different. Based on projected Soviet imports of machinery and equipment from the West the USSR could account for as much as 3% or 4% or the machinery and equipment exports of some of the Western countries by 1980.

Moscow has frequently cited the importance of Soviet orders in helping the West through the recession, and, in fact, the recession has been a factor in the recent willingness of Italy and the UK to advance large lines of long-term credit at subsidized rates. But most Western European countries as well as Japan traditionally have sought to expand exports to the USSR; the major limitation has been Soviet demand, in part dictated by foreign exchange availabilities. These same constraints will limit the importance of the Soviet market in the future.

If the USSR continues to import Western technology, some of the assimilation problems might be reduced over the next ten years. For example, much will be learned from the Kama plant about equipping, integrating and managing Western-equipped plants. In the short or medium run there is no indication that the Soviet record with respect to assimilating technology quickly and on a wide scale will improve markedly, but some improvement is likely as Soviet experience in dealing with Western technicians, equipment and technology accumulates. In the long run, whether there will be more incentive for enterprises to upgrade technology is questionable. The USSR already has struggled with this problem for 10 years with no appreciable effect.

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#3c The Soviet ~~[illegible]~~ Game Plan

Technology -- Strengths and Weaknesses

The USSR traditionally has sought to tap the technological resources of the west to bolster its own lagging technological position. The level of Soviet technology varies greatly from industry to industry, partly as a result of Soviet economic priorities. Most notably, the military industrial sector has been given preference with respect to allocations of high-quality manpower and materials. Thus, sectors important to defense programs have flourished. The same is true of some sectors important to the USSR's massive investment program. On the other hand, industrial sectors concerned with consumers goods are, as a rule, saddled with outdated technology, supply shortages, and management problems that do not plague to the military sector -- or even key capital equipment producers -- to the same degree.

The basic industries whose output directly supports both military production and investment programs -- steel, fuels, electric power, producers equipment, and chemicals -- have indeed received sufficient priority so that their technology occasionally equals that of the West. But much of Soviet output is still produced with technology obsolescent by Western standards. Imports have been heavily weighted in favor of machinery, equipment, and production know-how to modernize these basic industries. In industries producing consumer goods, the USSR is operating at a technological level well below Western standards. Greater leadership concern with consumer welfare, however, has led to larger purchases of consumer-related technology.

Western Technology Wanted

In recent years the Soviets have stepped up their drive to acquire Western equipment and technology. Primarily, they have bought chemical plants, offshore drilling equipment, oil and gas field equipment, wood processing equipment, mining and construction equipment, motor vehicle manufacturing equipment, and food processing equipment.

The USSR is also actively interested in a wide range of other capital goods to improve its ability to produce integrated circuits, numerically controlled machine tools, very large and very small computers, avionics, computer peripherals, semiconductors, and communications switching equipment. It wants to obtain technology to manufacture construction equipment, oil field and pipeline equipment, industrial process controls, large tractors and heavy trucks, airframes and engines, and chemical equipment. But Western technology for consumer-related products are on the shopping list too -- for example, machinery for making tin cans, paper containers, room air conditioners, artificial fibers, and color TV picture tubes.

Large amounts of Western technology will be employed in developing Siberia. They have purchased large Japanese and US tractors for timbering, pipeline, and railroad construction operations, and they have purchased US mining trucks with capacities in excess of 100 tons for open pit coal mining. The USSR excels in blast furnace operations but will spend $1 billion on the new Western technology for the direct reduction of iron ore because the availability of cheap fuel and electric power make this process economical in Siberia. Because the Siberian gas fields are remote from the major markets, the Soviets are buying large Western pipeline compressors, automated pipeline valves and remote control systems. The USSR is also seeking to use surplus hydroelectric power to produce aluminum, ferro alloys, and pulp and paper.

Channels Used to Acquire Western Technology

Overt Acquisition

Imports of machinery and equipment represent the main channel for the flow of Western technology to the USSR.

However, other channels of transfer have been increasingly used, including the acquisition of technical data, licensing agreements, cooperative production arrangements, collaboration in research, the exchange of S&T information with private Western firms as well as governments, attendance at international meetings, and visits to Western plants and laboratories. Moscow has been pushing hard to tap all possible sources of Western technology, both overt and covert.

The particular approach employed often seems to depend on what is expedient. Direct contact with Western scientific and industrial experts by those Soviet personnel who actually need or will apply the know-how is preferred over the use of non-technical intermediaries such as trade representatives or KGB officials. If the overt approach is unsuccessful, or the technology falls under COCOM restrictions, the covert approach is the ready alternative.

Moscow's highly-centralized direction of foreign trade coupled with its willingness to use all possible means of firms and institutions. Of the 170 technological agreements the USSR has concluded with Western companies, 38 are with US firms; five to ten more US agreements are expected by the end of this year. One of the strongest motives for Western participation is the hope of developing product markets. Advanced scientific technical knowledge can probably be more easily transferred through these agreements, which can include joint R&D projects and exchanges of data, personnel and the like, than through the government-to-government agreements. So far the implementation of these agreements has been spotty and our information limited, but the net flow of technology has surely been in the USSR's direction.

Covert Channels

The fact that much technology can now be obtained overtly should enhance the effectiveness for covert collection. Covert resources can be concentrated on a smaller number of targets and the access to targets will be increased by the numbers of Soviets involved in overt relationships with Western firms. The KGB has been tasked to intensify its efforts to obtain information in the United States, other NATO countries, and the PRC on particularly important work having military applications.

[redacted]

In laying out foreign intelligence tasks for the KGB, the major Western countries were ranked according to their technological development potential. The US was first, the UK ranked second; the Soviets expect the UK to continue serious research in many fields having military applications -- both for its own use as well as on contracts for the US. Japan and West Germany were put in third place, suggesting that the USSR believes S&T in these countries is becoming more military oriented. France was ranked next, with a notation that it possessed developed military branches and used of the latest S&T developments. In the last category, the PRC was identified as a potentially dangerous military country, and Israel, Italy, Canada, the Netherlands, Belgium, and Sweden were singled out as deserving attention from the point of view of military technology and science.

In terms of topics, the KGB's intelligence targets center on foreign military intentions, advanced military technology, and world-wide S&T developments having both military and civilian applications. The Science & Technology Intelligence ~~Service~~ Directorate of the KGB was to concentrate in 1972-76 on obtaining intelligence on:

-- Plans by potential enemies (above all the US), for preparing and carrying out a sudden attack on the USSR and its allies.

-- R&D that could lead to the development of new types of weapons of mass destruction.

-- Development of new or improved weapons systems.

-- Results of private or governmental S&T organizations (industrial or military) involved in the study of S&T trends, technological application and/or innovation, and the development of military and S&T doctrines.

-- The achievements of the principal Western countries that could provide maximum aid to the Soviet economy. The fields of chemistry, radio technology, electronics, and metallurgy were specifically cited.

As an example of the focus of the clandestine requirements, the KGB targeting in four of the six technological areas addressed in the present study* included:

-- Missile guidance. US MIRV systems including Minuteman and long-range (9000 km) submerged launch missiles with MIRVs. The increase in (foreign) guidance accuracy of the warheads was identified as an important task.

-- Computers. Improved fourth generation computers, using LSI, electro-optical devices, and holographic memory systems as well as mini computers. All categories of computer applications civil as well as military appear to be of interest.

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*The other two areas -- energy and agricultural technology -- were not mentioned specifically.

-- Aviation. High-speed multiple-purpose aircraft having long-range and high altitude performance. Supersonic transport and passenger aircraft with MACH 2.2-2.5 speeds. SST engines and high bypass ratio engines with greater economy of operation. The materials technology required to develop such engines such as new heat resistant materials, cooling methods, and high temperature lubrication materials.

-- Industrial Automation. Automation processes associated with semiconductor production, especially these designed to increase the reliability of the final product. New industrial processes for the production of fuels and other important chemical products. Computer driven control systems as a general category.

Civilian/Trade Promotion Technology

Petroleum Equipment

State of the Art

The United States is the world's leading producer of complete systems for onshore and offshore exploration, production, and pipelining of oil and gas. The most advanced geophysical equipment and related computer hardware and software can be acquired only in the US. US firms also manufacture the most advanced drilling and production equipment in the world. Only US companies, subsidiaries, or foreign licensees manufacture fully automated pipeline valves, compressors, and pumping equipment for large diameter pipelines. Permafrost technology in the West is controlled largely by US firms and their Canadian affiliates and subsidiaries.

Certain types of seismic and geophysical equipment are produced in France, West Germany, and the United Kingdom. Large diameter line-pipe and some oilfield equipment is produced in Western Europe and Japan. Some offshore technology is being developed by Dutch, French, Norwegian, British, and Japanese firms.

In general, the USSR is 10-15 years behind modern US exploration and drilling know-how. The Soviet Union lacks sophisticated geophysical equipment used routinely in the

West, such as modern seismic instruments and computerized field units to analyze seismic data. As the USSR strives to locate new oil and gas resources in permafrost areas and in deeper, more complicated geologic structures, the lack of such equipment will severely limit discovery capabilities. Poor quality drilling and producing equipment also is a bottleneck. Shortages of good quality casing and drill pipe, the lack of high quality drill bits, special drilling tools, drilling fluids, mud pumps, and blowout preventers contribute to inefficient operations in the field.

The Soviet turbodrill, which is used for about 70% of all drilling, is an excellent tool for the relatively shallow, hard rock formations encountered in the Urals-Volga region but is very inefficient below 8,000 feet. Continued heavy reliance on the turbodrill has contributed to rising costs and reduced drilling rates as depths of wells have increased. Because of the lack of processing facilities in the field, large volumes of associated gas -- 500 billion cubic feet per year -- are being flared, a particularly wasteful practice.

The USSR has only a slight capability to explore for and produce oil and gas in offshore areas. Although oil has been produced from deposits in the Caspian Sea for some 20 years, most of the output is obtained from wells drilled from a network of fixed platforms extending from the shore.

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The Soviets have only 4 mobile drilling platforms (jackup type) with only one capable of drilling in more than 200 feet of water to a depth of 10,000 feet. These and other shortcomings have led the USSR during the past few years to turn to Western suppliers for much needed technical know-how and modern equipment.

The USSR, however, has some strength in two areas of the petroleum industry. It conducts a waterflooding program in producing fields that is unique. Unlike Western oil producing countries that use waterflooding as a means of secondary recovery after formation pressure declines, the Soviet Union employs a water flood shortly after the initial stage of production to maintain oil flow. This procedure is designed to prolong the producing life of the field and increase ultimate oil recovery, but in practice serious mistakes have been made -- water has been injected in some cases at inappropriate pressures and with improper spacing -- resulting in low recovery of reserves at some major fields.

The USSR has laid more large-diameter oil and gas pipelines and has had more experience building pipelines in permafrost areas than any other country. Soviet accomplishments in this field, however, have not been without problems. For example, many of the pipelines do not operate at full capacity because of the lack of the required pumps, compressors, and valves which must be imported from the West.

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Soviet Attempts to Acquire Petroleum Technology and Equipment in the West

Soviet purchases of and contracts for Western petroleum equipment have risen sharply during the past 3 years (1972-74), totalling more than $800 million. Not included in this total are about $2.5 billion for large-diameter pipe ordered in 1974 from West Germany, Italy, and France. Almost two-thirds of the equipment and technology ordered or bought from the West since 1972 is for construction of pipelines, primarily for gas.

A vital part of the expanding Soviet energy base is the increased output of natural gas, primarily from deposits in the deserts of Central Asia, the permafrost regions of West Siberia, and from Orenburg in the southern Urals. Because gas can be delivered economically only by pipeline, the growth in gas production is dependent on the expansion of the network of large-diameter pipelines. About 30% of the total equipment orders were for gas processing and oilfield equipment. More than half of these orders were placed in France to be used in the development of the Orenburg gas field. Most of the US oilfield equipment ordered by the Soviets consists of submersible pumps (and spare parts) for increasing the fluid flow at older oil fields.

To date Soviet orders for geophysical and exploratory equipment have been small. However, such orders may increase. The rate of discovery of new oil reserves in the USSR is lagging badly, partly because of the poor quality seismic and drilling equipment. In recent months Soviet petroleum officials visiting the US have made offers to buy or obtain licenses to manufacture large amounts of US equipment for both onshore and offshore oil and gas exploration.

Potential Economic Effect on the USSR of the Acquisition of Western Petroleum Equipment

The USSR could carry out its petroleum exploration and development programs with its own equipment, despite the inadequacies, but at greater cost and over a longer period of time than would be the case if it had access to Western technology and equipment. On the other hand, difficulties arise in the use of unfamiliar advanced oilfield equipment from the West, especially when the Soviets do not specify the conditions under which the equipment is to be used and will not permit Western technical experts to supervise its initial operation. Nevertheless, imports of Western petroleum equipment and technology will become increasingly important to the Soviet economy. Expansion of the gas pipeline network will require Soviet imports of Western valves, turbines, and compressors in larger amounts during the remainder of the 1970s as domestic manufacturing capabilities are inadequate to keep pace with demands. Certainly the urgent Soviet need to locate new oil reserves will necessitate increased reliance on Western know-how, especially in the offshore

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areas of the Arctic and the Far East. Soviet technology in the use of mobile offshore platforms and subsea production is far behind the West, and without Western assistance in exploration and development any meaningful results in the offshore program would be at least 10 years away.

Coal

State of the Art

The level of technology in the Soviet coal mining equipment industry is, in general, below that of its counterparts in the US and Western Europe. The lag is greater in equipment for surface mining than in underground mining machinery. For example, the USSR has yet to put into operation a dragline with an 80-cubic meter bucket, the design for which was reported to have been completed in 1964. By comparison, the US coal mining industry has draglines in use with bucket capacities of up to 168 cubic meters. The largest Soviet trucks in series production for surface mining operations have a 40-ton capacity, less than one-fourth the capacity of the largest US vehicles. A recent article by Soviet technicians on surface mining of coal indicated that the USSR hoped to have dump trucks with a capacity of 75 tons and coal carriers with a capacity of 120 tons in series production by 1980.

Soviet Attempts to Acquire Technology in the West

In the late 1960s the USSR imported from Eastern Europe more than $100 million worth of large bucket wheel excavators for surface mining of coal in Kazakhstan. Purchases from the West of all types of coal mining equipment have averaged no more than $5 million annually in recent years. Substantial amounts of surface mining equipment, however, will be imported from Japan, and possibly from the US, for exploitation of coking coal deposits in the Yakutsk ASSR. In 1974 the Japanese agreed to provide credits of $450 million for this project with repayments to be made in the form of coal. In late 1974, the Soviets contracted to purchase from Japan 150 large crawler tractors for use in the Yakutsk coal field, and inquiries have been made regarding possible purchase from the US of ten 21-cubic yard electric mining shovels ($15 million), ten blast hole drills ($4.5 million) and eighty to one hundred 180 ton-trucks ($100 million). The Soviet shopping list for the Yakutsk project reportedly also includes truck cranes varying in size from 20 to 140 tons. Additional equipment and technology for surface mining of coal may be sought in the future as the USSR has ambitious plans for expansion of coal production by this means over the next 15 years.

Potential Economic Impact of Acquisition

Equipment for the Yakutsk project will enable the USSR to begin large-scale exploitation of coking coal deposits in this area as a source of foreign exchange. Deliveries of coal to Japan from Yakutsk are to reach 5.5 million tons per year by 1985. At present prices, the value of these shipments would be roughly $200 million. Later, the coal will also serve as a basis, along with nearby iron ore deposits, for further development of Soviet steel production.

Multiple-Use Technology

Industrial Automation

Background

Industrial automation is the technique of improving human productivity in the processing of materials, energy, and semifabricated parts by using machine self control (through feedback) and automatic product programming. Automation therefore excludes ordinary mechanization and "conveyorization."

Two major categories of processes susceptible to automation are distinguishable: (1) the flow processes -- e.g., chemical, petroleum, steel, electric power -- and (2) the machining and assembly of discrete machine parts -- particularly prominent in the manufacture of motor vehicles, tractors, railroad equipment, antifriction bearings, and pipe fittings.

The Soviets have been interested in automation and active in its development since the term was coined in the late 1930s. Their interest stemmed from the advantages automation offers for rapid large-scale industrialization -- increased labor productivity, improved control of quality, better use of inputs (reduction of waste), and higher returns to capital.

State-of-the-Art

The USSR lags behind the industrialized Western countries in the application of automatic control except in the automation of iron and steel furnaces and hydro electric plants. The Soviets were early innovators in the mechanization and automation of very large blast furnaces. They rival the Japanese as world leaders in blast furnace technology, with the US and Western Europe trailing. The USSR probably is the equal of other industrialized countries in controlling open hearth and oxygen converter furnaces, but lags considerably in the automation of rolling, tinning, galvanizing, and annealing thin steel sheet. They have serious problems in controlling sheet thickness and roll motor speed. US firms are world leaders in this area, but West German and Japanese technology is also excellent.

At almost all Soviet hydropower stations, including the very largest, the generating units are started up, connected into the distribution system, loaded up, and closed down automatically or by remote control centers. At the majority of Soviet steam power plants, the primary production processes are automated by a comprehensive centralized control system. The complexities of the stations with 300 megawatt (MW) generating units require the use of computers to collect and process performance data to properly dispatch power into the distribution system. At some 300-MW stations, control functions and data collection are carried out by computer on an experimental basis and the Soviets plan to install automatic computer control on ten of the largest thermal stations in 1975. A continuing shortage of computers has contributed to the lag in automation of steam power stations. The USSR has not sought to import equipment from the West for this sector although good technology is available in all the industrialized countries.

In the automation of chemical plants, the US, West Germany, Japan, France, Italy, and the UK are generally superior to the USSR. All export complete chemical plants to the USSR. The USSR has made a serious effort to automate process control in a few leading plants, but widespread diffusion of automation technology throughout the industry is still years away. The Soviets lack the broad experience of the Western industrialized countries in flow automation, and instrumentation and computers for monitoring and controlling continuous processes are not yet available in sufficient quantities.

There is reason to believe that much of what is termed computer control of processes in the USSR would be more properly called data handling and display, and that corrections to process parameters are made manually. In the course of selling modern petrochemical plants, US engineers have found that many Soviet engineers have only a rudimentary understanding of computer control of the processes. This discovery suggests that their experience with application of computers at major production facilities is small, although a few Soviet engineers have acquired a grasp of the technology from participating in automation programs at demonstration plants.

The USSR has been building pipe lines for years and has managed to install the necessary communications and automation equipment to operate many pumping or compressor stations by remote control. By 1962, the first installations with computers for measuring and controlling flows in pipelines had been completed. The USSR has also made considerable progress in automating the pumping of oil from wells to central collecting points. Not all Soviet investments in automation in this area are rational, however. The outlays for remote control of facilities in one oil field will not pay off from operating economies in less than 40 years, when the technology will be obsolete. In these technologies the US is the world leader.

The US exercises general world leadership in automating machining and assembly processes in the machinery industries, although firms in Japan and Western Europe are closing the gap and have taken the lead in a few instances. The use of automation in Soviet machine building is mixed. Automatic transfer lines are widely used for mass-produced parts, but too little use is made of ordinary mechanization. The USSR is probably at about the world level in design of automatic transfer machine tool lines, which it has been producing since 1946. It is below the world level in automatic assembly and in the application of numerically controlled (NC) machining to batch production.

Many Soviet automatic transfer lines have been made locally by enterprises that connect automatic and semiautomatic machines by automated conveyors of their own devising. At the start of the current Five Year Plan, the USSR had only two machine tool plants that specialized in producing automatic transfer lines, and these plants together could produce about 100 sets of equipment annually. By the end of 1975, six new specialized plants to produce automatic lines or standardized tools and components for them are to be in operation.

Numerically controlled (NC) machines have been growing as a share of Soviet cutting machine tool output, and in 1974 amounted to 4400 units of a total production of 255,000. In the US in 1974, of a total production of 57,875 cutting machine tools, 2757 were NC types. The Soviet assortment of machine tools includes some with a capability for contour cutting simultaneously in three or more axes, but most are controllable in no more than two axes simultaneously, and many have only point-to-point control. Soviet NC machines are weakest in their electronic controls and servo mechanisms.

The Soviets are beginning to produce machining centers with automatic tool changers but apparently are still in the prototype and demonstration phase of such advanced NC systems as computer numerical control (CNC), direct numerical control (DNC), and direct computer control of manufacturing systems connected together by controllable conveyors (CMPM)*. The East Germans seem to have made greater progress in advanced machining systems than the Soviets and apparently are working with them on NC applications.

The US leads the world in the technology of numerically controlled and computer controlled machining and manufacturing. This technology was born in the US in the early 1950s and

* Systems of this kind are called computer managed parts manufacturing (CMPM) systems. Another term for this is variable mission systems.

nurtured by the Defense Department until economic applications were found for it in the civilian economy. Numerically controlled tools now provide an economic means for producing parts in small batches, a scale of production that is typical of many investment goods and military products.

All the industrialized countries of Western Europe and Japan produce NC tools and machining centers. Outside of the US, the state-of-the-art is most advanced in Japan. Both Japan and the US have put CMPM systems into operation, but the US systems are more advanced because they can handle a larger assortment of parts. West European firms do not seem to be putting much effort into such systems at this time East Germany, however, has put several systems into service and probably hopes to supply them to other CEMA countries.

Soviet Interest in Foreign Automation Equipment

The USSR is not avidly purchasing the technology of industrial automation, per se. Its money is being spent for industrial production equipment, and, in the process, some very advanced systems of industrial automation are being acquired.

From a compilation of more than 800 large contracts for imported industrial equipment from the West in the last three years, less than ten appear to consist principally of industrial automation equipment. Of these, the most significant are automation technology for rolling mills and oil and gas pipelines. However, the Soviets have not acquired the technology of automation nor the know-how for producing automation equipment. They have bought only the equipment to automate specific installations. The assimilation of the design and production know-how embodied in the equipment is usually difficult.

Since 1968 the Soviets have bought between $1 and $2 million per year worth of laboratory instruments for defining the chemical and physical properties of gases, liquids, and organic compounds. While intended for laboratory use, the technology in these instruments can be adapted for the automated control of flow processes in the chemical industry. The quality of Soviet instruments of this type is below that of US equipment.

. The Soviets also have an agreement or scientific and technical cooperation, which includes, inter alia, data collection and communications, and industrial control equipment of unspecified types. The agreement covers exchange of information, production samples, acquisition or transfer of methods and processes, and know-how for the manufacture of products.

Significance of Acquisition of Automation Equipment

Economic

For the USSR, the principal economic advantages from automation are large scale outputs and uniformly high quality of product. Automation raises the productivity of both labor and capital. Automated processes set the pace for the workers tending them and obtain more useful hours each year than manually controlled processes, the utilization of which is affected by worker fatigue. Moreover, by providing continuous process control, automation ensures uniform quality of production and optimum use of inputs.

Some processes cannot achieve maximum production rates under conditions of manual control. High speed rolling of sheet steel with uniform thickness is possible only when the screwdown devices on the rollstands are under the continuous control of automatic thickness gauging equipment. The Soviets have had difficulty in this area, and recent purchase of such equipment from West Germany for the Novo Lipetsk mill will permit large increases in the production of hot rolled sheet.

The acquisition of Western automation equipment as integral parts of imported chemical plants is of great importance to the Soviets. The alleged poor quality of many Soviet chemical products -- e.g., polyethylene and polyvinylchloride for high voltage power cable insulation -- point to poor control of the production processes, a condition that can be corrected by automation.

The Soviets are also relying heavily on Western equipment to complete large diameter domestic pipelines. In addition to pipe, pumps, and compressors, they are importing communications and automation equipment. Automation will raise pipeline throughput, because it permits quick response to changing flow conditions at various points in the system.

The large number of automated machine tools imported by the USSR in recent years for the motor vehicle and tractor industries were necessary to supplement domestic supplies of tools for very large new factories. From the US the USSR ordered highly productive tools that are unavailable from Japan and Western Europe. The US, the UK, West Germany, France, Italy, and Japan all have sold substantial amounts of production machinery for the Kama plant. US firms got the bulk of the orders for automated transfer machine tool lines because of their greater experience and know-how in this technology.

The availability of NC controls and servo drives from the West is very significant to the USSR at this time. Soviet production of controllers and electro mechanical servo equipment for machine tools, like their production of computers and peripheral equipment, suffers from insufficient development and poor quality control. US visitors to Soviet aviation plants in early 1974 noted that Soviet NC machine tools were fitted with foreign transducers and resolvers and that many of the controllers had foreign tape drives.

Military Significance

An examination of the Soviets' want list for industrial equipment in the last three years shows little that would be of direct military benefit to the USSR from industrial automation per se. They have acquired equipment specifically designed for civilian products. Usually, automated equipment is uniquely specialized for the production of certain parts and products. Automation that controls chemical plants, cement plants, steel plants, electric power stations, and pipelines is dedicated to the installed task. Moreover, no readily identifiable military activity or product can employ these particular automation devices.

Automation for parts machining and assembly needs a closer look. Automatic transfer lines can be changed to machine very similar products if their sizes do not change much. The Kama Truck Plant transfer lines are designed to machine parts for a medium-sized truck engine and probably cannot be re-used to machine parts for very large tank engines, especially since the Soviet tank engine is completely different from that for the Kama truck.

The Kama foundry could be converted to make castings for military products but this would idle the special machine shops. Moreover, the foundry was designed to produce castings for 250,000 engines and 150,000 trucks each year. No military requirement exists for similar sized non-truck parts in that volume, so much of the foundry would go unused if converted to military products. This is primarily a cast iron foundry, a material not much used in military products.

It is possible to transfer to the military industries the know-how built into the automation of Kama's manufacturing processes, but the automation equipment obtained from the US, Western Europe, and Japan for truck production is not essentially superior to that produced in the USSR. The Soviets were as capable of automating the production of military products before buying the Western equipment for Kama as they will be afterward.

Multiple-Use Technology

Computers

State-of-the-Art -- West

Manufacturers located in the UK, France, West Germany, and Japan are the major non-US sources of technology in advanced computers and related equipment, -- specifically, large-scale digital computers and high capacity auxiliary storage devices. Other Western Euorpean countries such as Italy and Sweden are important sources of technology in very selected computer products, such as paper tape equipment.

In addition to domestic computer companies, the UK, France, West Germany, and Japan have major subsidiaries of US firms which are engaged in the development, production, and distribution of computers and related equipment. A large percentage of computers installed in these countries, and often the most advanced varieties available, is of US manufacture. US computer company facilities in these countries are also important sources of trained and experienced computer personnel who can support domestic computer programs.

The technology base upon which most of the foreign computer companies have developed their products is also of US origin.

Current computer systems offered by Japanese and Western European manufacturers also incorporate US-manufactured components and subsystems, particularly advanced semiconductor components and peripheral equipment such as magnetic disc units. As long as the US maintains its strong technological leadership in these component and equipment areas, foreign dependence is expected to continue, although both France and Japan have strong programs aimed at reducing their dependence on US products.

No manufacturer in Japan, the UK, France or West Germany offers digital computers comparable with the largest US models such as the CDC 7600 or the IBM 360/195. The largest models commercially available from these countries approach but do not match the overall capabilities of the IBM 370/168 which has a processing data rate (PDR) of more than 250 million bits per second (mbs).* These models are offered by the United Kingdom, West Germany, and Japan. All four countries have announced during the past year new lines of computers to be competitive with the IBM 370 series. Most of these new models are scheduled for delivery later this year and next year, but the firms may not be able to produce them in quantity in this time period.

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* The processing data rate does not accurately reflect the power and performance of many computers in today's market, but currently is the only recognized measure of computer power comparisons.

State-of-the-Art -- USSR

In the USSR as in the US, digital computer developments of the early 1950s were largely aimed at solving scientific and engineering problems, in many cases, defense related. In the late 1950s computers were used increasingly for military needs but their considerable potential for civil uses, including business data processing, was recognized and begun in the US, but in the USSR virtually all production model computers were for scientific and engineering problem solving into the late 1960s. Since 1967 data processing has received growing emphasis, but it will be well into the 1970s before the Soviets are likely to have the kinds of equipment, software, and experience which now play a significant role in US military as well as civil data processing applications.

The USSR is well behind the US in the quality, performance, and number of computers for general purpose uses. Soviet openly-announced general purpose computer hardware including central processing units, internal and peripheral storage, and input/output devices are approximately equivalent to some US 1965-66 models. Computer maintenance, software, training support and documentation in the USSR lags somewhat more than the hardware. Although the USSR is close to the US in the comprehension of advanced computer theory and is only a year or so behind in experimental work, it has yet to translate basic R&D achievements into high quality and quantity production.

In general, small- to medium-scale models based on discrete transistor circuits dominate the USSR's general purpose computer inventory. The Soviets are judged to have made a limited number of computers specifically for classified uses which may be four to five times more powerful than their biggest openly announced model, the BESM-6 (PDR = 20-25 mbs).

The most publicized current computer development program in the USSR is aimed at using integrated circuits to build the Ryad series of computers copied from the IBM 360 series The Ryad series is being developed in cooperation with other CEMA countries and it is to include a complete line of compatible peripheral equipment that are to be standard models in all the countries involved. Plans for 1970-75 announced for the Soviet Ryad computers appear to have slipped at least 2 years. Two models, the R-20 and R-30 corresponding to the IBM 360/30 and 360/40 models,* respectively, are reported in production, but only significant numbers of the smaller model, i.e. 200-300, are claimed to have been made. Production of the R-50 -- comparable to the IBM 360/65 (PDR = 29 mbs) -- before 1977 is doubtful and a larger planned model, the R-60, does not yet appear to exist even in prototype.

Designs copied from IBM and other US companies also are being used in the ASVT computers recently introduced into production and intended for use in industrial planning and control. The largest of the ASVT models, the M-4030 corresponds to the IBM 360/50 (PDR =9.3 mbs) and smaller models, the M-5000, M-6000, and M-400 -- based on US

* The 360/30 has a PDR of 1.1 mbs and the 360/40 has a PDR of 3 mbs.

minicomputer designs -- are now beginning to appear. Peripheral devices in the Ryad series also are used with the ASVT computers.

Until very recently the USSR has neglected minicomputers of the types that have been used in large quantities in the US since 1967-68. Lags in minicomputer developments deprived the USSR of important assets for establishing teleprocessing systems and computer networks. Some experiments on microprocessing have been reported but no Soviet off-the-shelf types for a wide range of industrial and possibly military uses have been revealed.

There have been a number of fragmentary reports on special computer developments for classified areas. Some of these were general purpose types but most have been specialized. In some cases the Soviet designers appear to have experimented with advanced or novel logical design concepts which probably would be too expensive for use in quantity civil products. Also some of these classified projects used components and circuit techniques which had been revealed in literature but which have never appeared in openly announced computers. To date, Soviet weapons system developers have tended toward designs that can be satisfied with less sophisticated computers than are used in US systems. Soviet uses of computers in military logistics, communications and command and control applications similar to US civil data processing uses still appear to be in early or experimental stages. This lag may be due to a lack of enough general purpose computers and related equipment in the USSR comparable with the civil products used by the US military.

The Soviets have continuing serious deficiencies in most types of peripheral devices needed to make effective use of their computers. Punch card and tape devices probably are adequate though below Western standards, but good line printers have not been available. Magnetic disc units comparable with mid-1960 US vintage are claimed in production but good disc packs still are a problem. Magnetic tape units have improved but supplies of good quality tapes are inadequate. Magnetic disc units and tape units from Bulgaria have been used with both Ryad and ASVT computers. Smart terminals and interactive graphic display terminals are not yet readily available for general use and good communication channel interface devices also are lacking.

The Soviets have a small number of centers with very strong capabilities for software and computer language research but until now machine language programming has predominated. This will change markedly as the Ryad type computers with their broad range of software copied from

IBM become available. As more and more general users, who are not computer specialists obtain computers, use of higher level language programming will become essential.

Soviet lags in supplying good integrated circuits and other advanced components has been an obvious constraint on their ability to supply large numbers of modern computers to general users. These lacks also constrain computer developments by specialists who do not have sufficient priority to get scarce components. The Soviets are able to produce fair quality ferrite cores and plated wires for memories, but they have been an successful in assembling quantities of core memories using the very small diameter cores. The Soviets appear committed to the use of ferrite cores for main memories for the next few years. They are doing research on semiconductor memories similar to those of modern US computers, but for a few more years they are not likely to produce adequate supplies of suitable semiconductors without foreign assistance.

<u>Soviet Attempts to Acquire Western Computer Technology</u>

During the past year the USSR has continued efforts to acquire large computer systems and computer technology in the West. Efforts are concentrated mainly in the United States, but there is activity in Western Europe and Japan as well. The Soviet Union is pressing for comprehensive deals that include technology, equipment, and training. It is also seeking computer peripherals and components. The Soviets appear willing to purchase in large quantities only if production technology is included. Finally, the Soviets seem bent on exploiting bilateral S&T agreements with the US government and with US firms to gain technical advice in problem areas of both hardware and software. The Soviets want information at a level of detail that would constitute a technology transfer.

Specifically, the Soviets want the following:

- Computers for high priority, non-military applications where requirements for speed and capacity exceed the capabilities of domestically produced computers; for example, for management of the Kama Truck foundry; for research applications such as high energy physics and for global weather forecasting. These deals involve very large, time-shared systems, with all system analysis, software and training provided.
- Know-how to produce high capacity magnetic disc drives and related disc packs; technology for other peripherals and supplies, such as high-speed printers and magnetic tape.
- Turn-key facilities to produce computer components such as integrated circuits for

- Licensing for the production of mini-computers; these will be used to implement Soviet plans for industrial automation, and to set up teleprocessing systems.

As the Soviets become more committed to modern large-scale computer applications they will be less able to satisfy their needs from domestic sources, and will need to acquire hardware and software from the West, or forego their demands.

Potential Economic Impact of Computer Sales to the USSR

The Soviet Union is pursuing a long-range plan for an integrated nation-wide network of computers for management and planning, and for the wide use of computers in the direct control of production processes. The extent to which Western technology can aid in these goals depends on the form and amount of the assistance provided.

Sales of discrete subsystems are beneficial to the USSR only to the extent that they can be incorporated into domestically produced computer systems without Western assistance. That capability has not been demonstrated. Such sales can provide the Soviets with limited design and manufacturing information, but not in sufficient detail to permit the item to be reproduced.

Acquisition of large quantities of Western peripherals or components together with technical aid for their incorporation with Soviet parts could help solve the current critical shortage of reliable computer subsystems, but the Soviets have shown little enthusiasm for importing large quantities of peripherals or parts under any conditions, as they are reluctant to become dependent on Western supplies.

The potential impact of sale of discrete computer systems is proportional to the volume of such sales. A large number of Western computers, even with minimal support, could have significant benefits especially for the management of large industrial complexes, and probably also for planning. However, as with subsystems, the Soviets seem unwilling to import large numbers of computers because it would force dependence on the West for spare parts. A small number of discrete Western systems would be of some benefit to the USSR, but the benefits would be restricted to a specific installation and would have little effect on the economy, generally.

Sales of computer systems with full installation and maintenance support could yield substantial extractable benefits in the area of software and systems analysis. For example, training and experience included in the proposed sale of the Kama computer system will contribute to the development of a cadre of Soviet specialists capable of training other specialists. Moreover, trained specialists will be able to apply their skills to the development of similar native software systems.

The sale or licensing of manufacturing technology would be of enormous benefit to the USSR; it would permit the USSR to produce modern, highly reliable third-generation computers and to produce them efficiently. Current Soviet models are technologically inferior to Western models and are produced inefficiently and at high cost. Such sales would not necessarily improve computer utilization, which probably would require further assistance in the form of programming, systems analysis, and maintenance training.

Cooperative or joint ventures are possible in the area of R&D applications, support, manufacturing technology, or some combination of these. A truly comprehensive agreement along these lines including provision for follow-on technology would provide the greatest benefit to the USSR. It would allow the Soviets to develop an advanced native manufacturing and utilization capability, while allowing them to keep up with the latest developments in the West. The current computer gap would be decreased significantly, although some gap probably would persist as long as major innovations continue to occur in the West.

Potential Military Impact

Military benefits from computer technology can be divided, with some overlap, into two categories. The first category includes the use of general purpose computers either in military R&D problem solving or in connection with communications and command and control. The second category includes the use of computers, usually special purpose, as integral parts of weapon systems.

Direct diversion of a small number of imported high performance Free World computers to support military R&D developments undoubtedly would be of some benefit to Soviet military projects. Realization of these benefit, however, would be hindered by the need for reprogramming of on-going problems and by the jeopardy to security of classified Soviet projects due to needs for spare parts and maintenance support.

The systems analysis, software, training, and experience gained through the acquisition of Western computer systems for civil uses probably would provide the greatest potential benefits to Soviet military capabilities. Systems such as those being acquired for airline reservations, Kama River Truck Plant, and Intourist reservations require that the Western supplier provide the Soviets a great deal of support in the above areas. This knowledge and experience can then be transferred to the development of their own advanced military systems which have many functional similarities to the civil systems obtained from the West. The Soviet military intends to use Ryad series computing equipment, which uses designs for US general purpose computers, for military applications similar to the civil applications for which they are now trying to acquire Western computer systems.

With respect to specialized computers for use in weapon systems, the Soviets are most likely to make important gains from their determined effort to acquire Western production know-how and production equipment. Although they may have used some imported components in special purpose military computers, particularly in experimental or prototype stages of developments, their main emphasis is on capability to meet deployed system needs from domestic sources. Cooperative R&D programs with Western companies also could made significant contributions to Soviet capabilities for developing specialized military computers for signal processing and for uses requiring untended, long-term reliable operation.

Some of the cooperative programs also call for construction of facilities for producing advanced computer peripheral devices and components. This type of technology would contribute to the Soviet base for supplying a wide variety of military computer needs.

Civilian/Trade Promotion Technology

Soviet Agricultural Technology

Technology Gap

Agriculture is the most technologically backward sector in the Soviet economy, lagging far behind that of the US. As a result, the Soviet farm worker produces only 11% of the output of his US counterpart, applies only 48% of the fertilizer allocated to US crops, and uses much less machinery per acre than in the US. Only 80% of the potato and sugar beet crops and about one-third of the cotton crop are harvested mechanically. Specialized machines such as carrot harvesters, tea pickers, and grape pickers have been used experimentally, but the level of mechanization in vegetable and fruit growing remains low. Little mechanization is used in Soviet livestock production. Only about 5% of the poultry in the USSR is raised on fully-mechanized operations, and almost 60% of the milking in the socialized sector is still done manually.

Soviet Interest in Western Technology

Soviet leaders now are stressing farm modernization and are soliciting Western help. Under the 1973 US-USSR Agreement on Agricultural Cooperation the Soviets proposed technological exchanges in genetics, selection, and seed production of grains and soybeans; feeding of farm animals and the design of large livestock complexes; optimal application of chemical fertilizers, perfection of technology and systems of machinery for crop cultivation and harvest; techniques of land reclamation.

Tractors

Since the early 1930s, when US firms were instrumental in designing and equipping the first Soviet tractor plants at Kharkov and Volgograd, the Soviets have looked to the US for assistance in the area of farm machinery. The Ninth Five-Year Plan was expressly designed to upgrade tractor quality and performance and to bring tractor design and technology closer to that in the West today. Plan directives call for delivery to agriculture of 1,700,000 tractors that will be more powerful, durable, and faster.

For years, the Soviets have favored tracklaying over wheeled tractors. They now recognize that the tracklaying type is not as versatile as the wheeled type in agricultural applications. Consequently, they face the tremendous task of not only meeting their overall requirements for large numbers of additional tractors but of replacing most of the tracklaying tractors with wheeled types, and of replacing low-powered wheeled tractors with more powerful machines. To this end the Soviets are actively in contact with US manufacturers:

1. In late 1973 they approached a large US diesel engine corporation to obtain 450 horsepower engines for use in agricultural tractors. They appear to want to buy the technology so they can produce the engines themselves.

2. In November 1974 they provided specifications to a US manufacturer for a proposed 500 horsepower wheeled tractor, possibly to be designed and manufactured with US assistance. Such a machine is needed for pulling heavier implements at higher speeds.

3. They have expressed interest to US firms in a 4-wheel-drive, 170 horsepower-range tractor featuring hydrostatic transmission. Such a tractor would supplement the the 165-horsepower 4-wheel drive tractor currently in production at Kharkov.

Since 1972 the USSR has purchased several thousand tractors from the US and Japan, but these have been construction-type, tracklaying machines for industrial projects such as pipelaying and open-pit mining. Little interest has been shown in purchasing large numbers of Western-made tractors for use on Soviet farms. Trade discussions have typically centered on technical cooperation, participation in Soviet manufacturing facilities, licensing agreements, and construction of turnkey plants.

Feedlots

Feed is the important factor in animal husbandry. Its mechanization in general and properly coordinated mechanization in particular is a close runner up for large scale operations. During 1971-75 the Soviets were to deliver 6.5 billion rubles worth of machinery and equipment for the mechanization of animal husbandry and "feed procurement." According to officials of the Soviet Ministry of Agriculture, the USSR plans to build over 1000 cattle feedlots in the next 5 years. These will be located in the Ukraine and in Soviet Central Asia where extensive irrigation projects are under construction. In 1973 the Soviets contracted with a US firm, for the construction of 3 feedlots: a 30,000 head facility near Krasnodar, and 20,000 head faciliites near Volgodonsk and Tbilisi. While is providing only equipment for the Krasnodar and Tbilisi feedlots, the Volgodonsk facility is a turnkey operation. The latter went into full operation in 1974, and Soviet officials have been very pleased with the progress achieved so far. The feedlots provide grain storage facilites, a feed mill, trucks for transportation, feedyard equipment, and the farming equipment to grow and harvest the needed foodstuffs locally.

The Soviet goal of constructing more than 1000 feedlots in 5 years appears tremendously optimistic. Although the Ministry of Agriculture has apparently received ample funding for this program, the Soviets lack sufficient technical and administrative understanding of the operation of large scale cattle feedlots to enable them to accomplish such an extensive program. Their knowledge of animal nutrition is entirely inadequate for such a program, and the size of their operations will necessarily be limited by the unavailability of the small process control computers which are utilized in the US to control the apportionment of feed rations and other such operations. A more likely achievement would be the construction of 200 to 300 smaller feedlots on the larger state farms each with the capability to feed perhaps 2,000 to 3,000 head.

Feed Production Plants

One of the most important shortcomings of the Soviet cattle feed industry is inadequate processing and distribution. The short growing season which prevails in the USSR makes early harvesting imperative, and the roughage that results is utilized in a green, unconcentrated state that has a very high water content. This not only increases the amount of feed an animal requires, but it also reduces the nutritive value of that received. Thus, weight gain is rather slow in the average Soviet cattle herd. The second deficiency is that the bulky, unprocessed feed cannot be shipped the long distances from where much of it is grown to the areas where it is needed, and while feed may be abundant in the one area it can be in short supply in another.

In May 1974 the USSR requested US quotations for 1975 delivery on 5 complete plants for the production of a urea-based animal feed. In September the request was reemphasized and increased to 20 plants. Each plant will contain 5 extruders and associated storage bins to provide a production capacity of 1.4 metric tons of protein concentrate per hour. The extruders combine grain, urea, and bentonite pre-mix into an animal feed which can contain as high as 85 percent protein equivalent for ruminant animals. The process is under high temperature which permits the nitrogen from urea to be combined in the starch of the grains.

This eliminates many of the problems associated with urea feeding. The USSR will have to import bentonite pre-mix from the US because the only known deposits of sodium bentonite are located in Wyoming and Montana. The total price for the feed plants, technical assistance, and 2 years of spare parts will probably exceed $4 million.

High level emphasis is also being placed on acquiring a manure recycling process

The Soviets have repeatedly asked for bids on different sized facilities, and are very interested in a recent proposal submitted by the US company. This would call for the establishment of a plant utilizing the company's process for recycling manure into cattle feed in conjunction with an appropriately sized feedlot. In addition, US equipment for cutting, drying, and cubing alfalfa and other roughages would be provided. Roughage could thus be thoroughly processed and cubed so that it could be easily shipped throughout the USSR and stored for as much as 2 years. Only US companies make equipment in this field on the scale in which the Soviets are interested.

Two million dollars worth of this US equipment was exhibited, at Soviet request, in Moscow in 1974 and purchased afterwards by the Soviets. Included was a $700,000 dehydration plant.

Alfalfa Harvesters and Processing Plants

In October 1974 the Soviet Minister of Machine Building for Animal Husbandry and Forage Production, K. N. Belyak, indicated to a US company that the USSR wants to purchase the license and one complete plant for the production of a US-made alfalfa harvester, with an overall plan to build 1100 harvesters. Belyak was also interested in alfalfa processing plants. He said that the USSR has a need for 350 of these plants but would settle for 100-200. Initially he would like to buy about 15 plants -- one for each Republic -- and acquire the licensing rights to build the rest. The plants come in 3, 5, and 10 metric-tons-per-hour capacities, but the Soviets are only interested in the largest size. The Soviet requirement is for a machine that will dry a raw product from 78-80 percent humidity to 10-16 percent humidity at 10 tons per hour, with loss of carotene no more than 10 percent at drying and 5 percent at pressing. Belyak preferred a 65mm-sized pellet, but when advised that this is not a practical size to produce he accepted 10, 15, 25, and 30mm pellet dies. Pellets of these sizes will give the Soviets the capacity to feed poultry, hogs, and cattle. The interest in a 65mm pellet indicates they are more interested in feeding cattle than smaller livestock.

The Soviets have scheduled the development of this project over a 5-year period with a final goal of complete Soviet independence in this area. Belyak stated that when his Ministry completes the preparation of a comprehensive schedule in late 1974 a formal contract will be signed with the US companies involved. The overall cost of the licenses, engineering and technical expertise for the alfalfa harvesters, and the plants for processing and alfalfa into pellets would probably be between $60 and $70 million.

Silo Construction

At the beginning of 1971, there were only 123,000 silos in the USSR with a maximum capacity of 22-23 million metric tons of processed silage. The amount of silage and cured hay produced in the USSR in 1970, however, was 160 million metric tons. Thus, 85 percent of the country's silage was inefficiently stored. Much of it is simply piled by the roadside or put into barns and sheds where it soon rots. Almost one-third of state-procured silage was estimated as being spoiled in 1970 and more than half of its feed value lost. Storage improvement, then, offers a tremendous potential for reducing feed shortages which the Soviets have only recently begun to emphasize.

In 1969 the Soviets signed a $2 million contract Besser orpo [illegible] for the delivery of 5 complete automatic plants for the manufacture of concrete blocks for silo construction. [illegible]

[illegible] The contract specifies, however, that the Soviets are not to manufacture the machinery nor transfer the technology to third parties. Soviet officials stated that after the performance of the initial plants have been evaluated they may purchase additional [illegible] plants. Be [illegible] they will need at least 25 plants nationwide.

Another US firm reached an agreement with the Soviets in 1972 to supply metal accessary parts for concrete silos. The firm is selling a number of machines to fabricate the accessories and also the know-how. The Soviets should be easily able to manufacture the machinery and accessories in the future.

Fertilizer

It is difficult to exaggerate the importance of fertilizer to agriculture. Of the numerous ways of increasing crop yields (fertilizer, improved varieties, irrigation, pesticides, farm machinery) fertilizer is probably the most important and financially rewarding. Within the Soviet Union it is playing an increasingly important role, particularly as a method of raising grain yields. For exmaple, during the five-year period ending in 1975 more than 50 percent of the planned in grain production, i.e., an average of 18-20 million tons per year, was based on larger amounts of fertilizer.

The Soviet Union has made definite progress in supplying the agricultural sector with fertilizer. The total availability of fertilizer was increased more than nine times between 1950 and 1971. In 1972 the Soviets produced over 66 million tons of fertilizer, almost as much as the US. But acreage in the USSR is 70 percent greater than in the US and 66 million tons does not begin to meet Soviet needs. Moreover, the quality of Soviet fertilizer is poor, single nutrient materials predominate, and phosphate fertilizers are in chronically short supply. Other shortcomings in the industry include delays in new construction, poor operating efficiency at existing plants, and transportation and storage problems.

To alleviate some of these problems the USSR since the mid-1960's has purchased from foreign countries fertilizer production equipment, including complete plants for production of multinutrient fertili~er and key intermediates, such as ammonia. In 197: ccidental Petroleum Corporation signed a 20-year barter deal with the USSR worth $8 billion for the construction of eight ammonia and two urea plants in the USSR. The barter portion of the arrangement provides for the exchange of ammonia and urea produced in the new plants plus Soviet potash for US phosphoric acid.

The agreement provides several specific advantages to the USSR:

1. Soviet industry will acquire modern technology for the production of ammonia, the basic ingredient of all synthetic nitrogen fertilizer.

2. The expansion of urea production will allow for increase in its use as a feed supplement for cattle and thereby have a significant impact on the critical Soviet "feed protein" problem.

3. Imports of US superphosphoric acid will help reduce the shortages of phosphate fertilizer. At least half of the arable land in the USSR is deficient in phosphorus and larger supplies are expected to increase crop yields, raise protein content, and speed the ripening of grain. The latter is an important consideration in regions that have a short growing season.

The priority now accorded fertilizer production by the Soviets is likely to continue into the 1980s. Domestic production of fertilizer is certain to increase greatly during those years; however, persistent Soviet problems suggest continuing interest in Western fertilizer production equipment ranging from additional plants for the production of raw material, such as ammonia, to granulating and packaging machinery.

Pesticides

Soviet agriculture also needs assistance in developing pesticides. Losses from insects, weeds, and plant diseases may be as high as 30 percent of potential yields. This is largely attributable to the fact that because of a shortage of pesticides only about half of the total sown area is being treated. Also, with the exception of cotton and certain other industrial crops which receive special attention, the rate of application for those crops that are treated is necessarily less intensive than that recommended in the West. Supplies of pesticides continue to fall short of requirements despite increased production over the past decade. In 1970 the USSR reportedly met its needs for insecticides and fungicides by only 60 percent, and for herbicides by only 50 percent. Prospects are poor for filling this gap between supply and demand in the next 5 to 10 years.

Although the major types of pesticides are manufactured in the USSR, the variety of products available to agriculture is very limited. Only 150 basic pesticide chemicals are produced in the USSR compared to 900 in the US. One reason is the Soviet attitude toward toxic preparations which has limited the number of pesticides available at any one time and slowed the introduction of new compounds into Soviet-agriculture. Their stringent interpretation of toxicity, in relation to the environment, has resulted in the phasing out of certain highly toxic compounds in favor of less toxic types. This attitude limits sales of both pesticides and manufacturing plants to the USSR, and aggravates the problems caused by a high level of crop losses and pesticide shortages.

The structure of Soviet purchases of pesticides from the West has changed in the last few years from large quantities of formulated pesticides to supplement domestic production to smaller but increasing amounts of more expensive, highly active ingredients for formulation in the USSR. In the same vein Techmashimport* has expressed an interest in purchasing US licenses and technology for the construction of a chemical pesticide plant capable of producing at least 1500 tons of a particular fungicide per year. The Soviets have also requested a US firm to quote on a turn-key chemical plant that could produce 5000 tons per year of a trade-name pesticide, plus the training of the Soviet personnel required to operate the plant. Another US firm attempting to sell a nematocide to the Soviets is resigned to the fact that if a sale is negotiated they will be selling the technology, not the product.

The pattern is clear. However, despite their obvious preference for purchasing a manufacturing plant rather than a ready-mixed product it does not appear that the Soviets are attempting to become self sufficient in pesticide production any time soon. On the contrary, it would be to their advantage to continue to purchase the new compounds, and/or the technology for their production, developed through more advanced Western research in this area. In support of this line of reasoning a major Soviet study on pesticides, initiated following a period in which their pesticide production quintupled, was to determine, among other things, which pesticides would be produced in the USSR and which would be purchased abroad.

The present limited variety and known pesticide shortage in the USSR almost assures that the Soviets will be looking to the US and other Western countries for the advanced technological help they need, at least until 1980 and probably beyond. To date, however, although several negotiations have been reported, no contracts with US firms for pesticide technology are known to have been signed.

Land Improvement

Agriculture is possible in one-third of the USSR, but only about 10 percent is cultivated because the rest lies in areas without sufficient rainfall. Thus the problem of developing agriculture in the USSR depends on the reclamation of land and especially on irrigation. Drainage, a

* The Soviet agency for machinery imports

less expensive method of reclamation, has had considerably less emphasis during the course of the five-year plans. But both irrigation and drainage are now being brought to the fore because of lack of alternative opportunities for a major expansion of cropland.

Primary water sources are damned reservoirs, rivers, and irrigation ditches. The Soviets have developed an excellent canal system to channel snow melt and rain from the mountains into the desert regions. The major drawback to their system is insufficient reservoirs and inadequate distribution systems on the farms. In fact, the USSR has a poor record in maintaining drainage and irrigation systems in operating conditions. For example, in the past the covered and tiled drainage systems which are scheduled to expand rapidly and to account for more than half of total drained acreage in 1975, have been built with inferior tile that collapsed under the weight of heavy farm machinery. In irrigated areas about two-fifths of the land is subject to salinization to some degree. Annual washings carried out in rotation to lower salinity remain partially ineffective because of disrepaired and uncleaned collection and drainage networks. As a result of these and other problems, the rate of retirement of reclaimed land from production has been high enough in the past to nullify the sizeable acreage added annually.

The Soviets now have some 30 million acres under irrigation, compared to 50 million in the US. Five million acres are under sprinkler systems, about half of which are central pivot systems manufactured in the USSR under license from a Nebraska firm, The Soviets paid 300,000 for its technology several years ago, and have visited the US plant at least twice since then to review production techniques. They now want to negotiate (1) a licensing agreement on a new add-on system that irrigates the corners of a field not covered by the circular pivot system, and (2) the technology for a plant to galvanize the steel pipe required for these systems.

The USSR is working on a plan up to the year 1990 to irrigate an additional 50 million acres. In 1974 the Soviets spent more than 5 billion rubles on capital investment for melioration and irrigation; in the next 15-18 years 150 billion rubles will be required to reach their land reclamation goals. The USSR would like to fulfill its goals by utilizing only Soviet resources and equipment, but the scale of work and technology required is too great. Consequently they have turned to the a US engineering firm with a good international reputation, for help. The Soviets have requested the US firm to submit proposals on a pumping plant, excavation work for diversion of water from the Ob River to the Caspian Sea area, canal lining techniques, jointless pipe, trickler irrigation, and ionic desalination plants. They are also interested in full automation of the irrigation systems themselves. If participation is acceptable to the Soviets and if negotiations on credits in the US are carried out successfully, the US company will be asked to contribute at increasing technical levels.

Crop and Livestock Improvement

The development of high-yield, non-lodging varieties of grain with drought and disease resistance is the major objective of Soviet plant breeders. Interest in improved varieties of grain has been stimulated by problems encountered in recent years. There has been a decline in protein and gluten content, and hence in suitability for milling and baking. At the same time, yields of forage crops have stagnated, placing the burden of supporting the expanding livestock program on feed grains. To help achieve their breeding goals, the Soviets have solicited germ plasm from US agricultural experiment stations and US commercial firms. Quantities of wheat and corn seed have already been purchased and the Soviets obviously plan to purchase additional seed of US varieties of these and other crops, viz. soybeans, sorghum, and alfalfa. In fact they are believed to be close to a major decision to invest $10 to $12 million in US corn and sorghum germ plasm, technical assistance in a breeding program, and seed processing plnats. The use of US germ plasm in their breeding programs may increase Soviet yields of corn and sorghum by at least 20 percent.

Feed supplies and an enlightened approach to genetic progress are the two biggest problems the Soviets face with respect to livestock production. The USSR needs to restructure its livestock breeds, especially cattle. Soviet agriculturists are only beginning to realize the advantages in feed conversion efficiency and cost reduction which specialized breeds and improved technology offer. They also realize that genetic improvement of their livestock is necessary before they can reach the quality standards achieved in the US. To narrow this gap the Soviets are importing some US breeding cattle. They believe that US and Canadian cattle are more adaptable to the Soviet climate than those of Western Europe. They have also dismissed the breeds of Argentina and Australia as not being the type animals they require. Besides US beef and dairy cattle, swine and goats also have been added in recent years to the existing foreign breeds in Soviet herds. All will be used in a long-range (10-15 years) program of crossbreeding and selection. In addition to these purchases the Soviets have a number of agreements with US cattle industry organizations whereby they receive livestock technology and methodology to assist them in their breeding programs.

The majority of the cattle in the Soviet Union are dual purpose (milk-beef) animals in which productivity is generally very low. Their quality is roughly equivalent to that of poor-grade Holstein in the US. They suffer severe inbreeding problems and are susceptible to all the common livestock diseases. The high quality US and Canadian beef cattle imported in 1971/72 are being used with these dual purpose cattle in a program of crossbreeding and selection. Crossbreeding is an effective way of improving quality in spite of past mistakes. The Soviets will probably continue to import bulls from the US in support of this breeding program. They are also interested in importing semen from US Holstein bulls. Actually an artificial insemination program using frozen semen from superior sires is a more rational approach to the vast crossbreeding program necessary to solve the Soviets chronic meat shortage. The Soviets claim that by the end of 1980 artificial insemination is to be extended to the entire livestock program.

The Soviets are also interested in improving pork and poultry production with US assistance. In their program to increase meat production, in fact, poultry has top priority, followed by swine, and then cattle. Although the Soviets have made impressive advances in poultry breeding in recent years, their birds are still poor feed converters. They have expressed interest in purchasing large numbers of US hybrid chicks, and last Fall the Soviet Embassy requested preliminary US bids on technical assistance in dairy cattle, pigs, sheep, and poultry.

Impact of Western Technology

The transfer of Western agricultural machinery and technology to the USSR will have a small impact on agricultural growth. The amount of imports will likely remain small compared with the size of the Soviet agricultural sector. More importantly, Soviet agriculture's lag has resulted largely from a myriad of organizational and incentive proglems, and poor climate, as well as inadequate technology. The speed of agricultural development through 1980 will depend more on improving the efficiency of existing resources in agriculture than on acquiring Western technology. The only area where Western technology is likely to have a significant impact is in mineral fertilizer. Fertilizer shortages have been a major retardant in grain yields, and Western chemical equipment will likely be crucial to Soviet plans to double application rates during the next five years. However, the impact again will depend upon the ability of farmers to use efficiently the additional fertilizer, which they have failed to do in the past.