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Licensing Into/Out of USSR

Soviet Union steps up technology licensing efforts; Licensingtorg plays key role

BY DIMITRY A. SOLOVYKH*
and IGOR L. VOINOV**

The large scale and complexity of problems faced by science and technology today intensify international economic relations and active technological exchange in such global fields as raw materials, energy, pollution, resources of the world ocean, eradication of the most dangerous and common diseases, and space exploration.

One of the most dynamic forms of intensive technological exchange is the license agreement.

For about 25 years now, Licensintorg, the Soviet Foreign Trade company, has represented Soviet inventors, industrial enterprises; and the ministries and government bodies of the country maintaining stable, growing links with foreign buyers and sellers of licenses, know-how, and engineering services.

The Soviet Union's high international prestige in various fields of science and engineering is recognized throughout the world. Hence there is increasing interest on the part of foreign companies and organizations in Soviet licenses pertaining to the key branches of modern industry that need much research effort. The association's export portfolio contains about 2,000 applications for original inventions, selected on the basis of analysis of modern trends of development of science and technology.

More than 2,000 companies and organizations in 40 countries worldwide have commercial contacts with Licensintorg.

Helps Solve Problems

Since 1962 when the association was established, Licensintorg has concluded over 1,000 export and import agreements and contracts. By exchanging licenses, know-how and other industrial property rights with foreign companies on a commercial basis Licensintorg helps to solve important global problems as well as those of particular industries in the national economies of the Soviet Union and of the countries where the association's partners are based.

Licensintorg promotes various business and trade relations between different Soviet organizations and their foreign partners. Its export-import activities are not confined only to the traditional forms of licenses, such as the license and optional agreements, and contracts of purchase-sale of equipment for license implementation. We try to diversify our forms of cooperation so as to satisfy, as completely as possible, the requirements of our foreign partners, on the one hand, and of the Soviet organizations and enterprises on the other.

Along with the transfer of rights for use of Soviet technologies, Licensintorg is ready to conduct, within the framework of the license agreement, development of technical and economic substantiation, preparation of projects within "basic engineering" or "detailed engineering," as well as to render technical assistance for all stages of license implementation and to provide other services.

Licensintorg regards developing license trade and cooperation with foreign trade organizations of socialist countries as a top priority. Most successful in this field are the Soviet technologies and developments in metallurgy, shipbuilding, electrical engineering, communications, etc.

Thus, various factories and integrated plants of the GDR have purchased licenses for torch gunning of converters and a method for manufacturing prestressed stands for rolling mills. The world famous Karl Zeiss Jena integrated plant successfully employs Soviet-designed techniques for making coquilles of rectangular lenses, and methods of checking physico-mechanical properties of grinding tools.

Licenses

Evaporation cooling systems for blast furnaces, a continuous phenol-formaldehyde plant, coke-oven batteries and other equipment have been installed at factories in Czechoslovakia under Soviet licenses.

A number of license agreements were concluded with the Hungarian industrial enterprises, including those for the Soviet evaporation cooling system for blast furnaces, which is used at Hungary's largest industrial enterprise, the Dunajvaros; a procedure for electroslag welding of aluminum conductors; a manufacturing process for powder wire; and production of units for oxygen-lance pipe cutting.

Licensing cooperation between Licensintorg and Bulgarian organizations has grown considerably.

The most important agreements on Soviet technologies include a synthetic diamond production method, making pipes from quartz glass, and Astra computer software for nuclear power plants, production of tunnel shields to lay service lines underground, mould casting with fine cleaning of ferrous alloys in the gating system-the FIRAM process- and producing citric acid by surface fermentation

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method, among others.

Licensintorg, in turn, buys, from the organizations and enterprises of socialist countries the most cost-effective production processes and equipment. Capitalist countries account for a considerable share of the association's license trade.

The most active partners are large and medium firms in Italy, France, FRG and Japan such as the Japanese Kobe Steel and Nippon Steel, West German Gutehoffnung Hutte and Schlomann Zimag, Italimpianti and Goldoni of Italy, and many others.

Achievements

Foreign specialists are attracted by achievements in many Soviet industries. Thirty-five continuous steel casting plants were built in a number of countries under Soviet licenses. Licensees for dry coke quenching plants include companies in Italy, Japan, Great Britain, Spain, and others. Klekner Humboldt Deutz, an engineering firm of the FRG, was the first to buy an original method for processing complex zinc-copper ores-KIVTSET-process.

The other buyers of this process are well-known world producers of lead, such as Broken Hill of Australia, Cominco of Canada and Samin of Italy. The Austrian firm Voest Alpine purchased a license for torch gunning, an accelerated method of repairing the linings of converters. Fried Krupp of the FRG and Kawasaki Steel of Japan are also licensees for this technology.

Licensintorg's cooperation with foreign companies in such a humane field as manufacturing of medical preparations is particularly noteworthy. They are now being made under Soviet licenses in the FRG, Italy, Great Britain and the U.S.

The first contacts with U.S. companies started in 1964. United States Surgical Corp. bought a license for a Soviet-designed method of manufacturing blood vessel suturing instruments. However, business at that time was mostly sporadic. Nevertheless, due to joint efforts of the association and its American agents, the number of signed export license agreements has been growing from year to year and at present this cooperation goes on a large scale.

Among the licenses for the most interesting Soviet technologies purchased by the U.S. companies are the following:

— Technology for production of air punchers that can operate underground without disturbing street pavement.

— The evaporation cooling system for blast furnaces, which was the first in industrial power engineering practice to recover the blast-furnace waste heat and to cut drastically electric power and water consumption.

— An underground coal gasification plant to produce fuel gas from coal in underground channels using a technique that eliminates any manual operation.

— Technology and the Bulat installation for making wear-resistant coatings.

— Technology for aluminum casting in a magnetic field.

— Technology and installation for contact welding of marine trunk pipelines developed by the E.O. Paton Institute of Electric Welding under the Academy of Sciences of the Ukranian SSR. The Soviet invention has made the welding process automatic and cut dramatically the time required for each welded joint. It increases productivity 4 to 6 times.

— Technology for production of cone-type inertia crushers.

— Methods of design of mass-exchange columns in industrial air-separating plants.

Medicine

In the field of medicine, licenses should be noted for such cardiovascular drugs as Entasin and others, for surgical sutural instruments, for methods of ophthalmic microsurgery developed by the staff of the Institute of Microsurgery under the guidance of Academician S. Fedorov.

Soviet science and technology have a powerful potential but we realize that no single country, even the most industrialized, can dominate in all the fields of knowledge and engineering. The import activities of the association are in full keeping with trends of the country's progress and planned development of the Soviet economy. The main objective of the economic and social development of the USSR is to raise substantially the living standards of the Soviet people. Agriculture is now developing at an accelerated rate, serious tasks are faced by power engineering, transport, and much is to be done in the spheres of improving the quality, reliability and durability of machines, of automating many manufacturing processes, and extensive introduction of robots.

In view of these tasks, the association actively buys foreign licenses and know-how. U.S. technology purchased in recent years includes an agreement with RCA Corporation for manufacturing color picture tubes as well as licenses for Sundstrand-designed transmissions, automatic Pure-Pak dispensers from Ex-Cell-O, sprinkling installations from Valmont, low-cutting reapers from Deere & Co., power sources for electrocardiostimulators from Catalyst Research, and technology for industrial production of cranberries from Summit.

A new promising and important trend in the technological exchange is now being increasingly represented by joint ventures, where each partner or one of them supplies his technology by way of his contribution to the joint venture.

For example, a number of Soviet pharmaceutical and medical research centers, as well as some other specialized R&D establishments, express their readiness to form a joint venture on the territory of third countries by transferring their laboratory findings to be further developed and commercially applied. Accordingly, technical assistance will be provided by the Soviet organization. This arrangement will make it possible for the laboratory findings to be accessible to the market within a short time and with proper account for its requirements and specific conditions.

In terms of organization of management of foreign economic relations of the USSR, another possibility lies in organizing joint ventures on the territory of the Soviet Union. Here the foreign partner contributes his technology for manufacturing of the product to be subsequently marketed in the USSR and worldwide.

At present new possibilities for developing co-production in industry and for the establishment of joint enterprises are offered to interested firms in capitalist and developing countries as well. The endorsed principles of establishing such enterprises combine both the specific

features of the Soviet economic system and the positive world experience of joint enterprise and joint activity in the sphere of production.

Joint enterprises can be established for the output of products currently imported from abroad. However, it is expected that at the same time they will carry out active export operations, including with the use of the marketing and servicing networks of both partners, the main areas of cooperation of interest to the Soviet side as of today are: the output of chemicals for use as pesticides, dyeing agents, chemical fibers and individual types of machines, as well as the pulp-and-paper, light, and food industries.

Joint enterprises are set up on the basis of joint capital with the share of the foreign participant not exceeding 49%. Its concrete contribution can take the form of equipment, technology or currency funds.

Joint enterprises shall not receive obligatory planned assignments from the Soviet authorities and shall determine their production programs themselves.

The foreign partner shall receive the right to the free transfer of profits and also of other assets due to it. A reasonable favorable level of taxation shall be set for it. The foreign partner shall have the right, within the limits of its established share of the joint capital, to reinvestment of its profits with a view to enlarging or modernizing production.

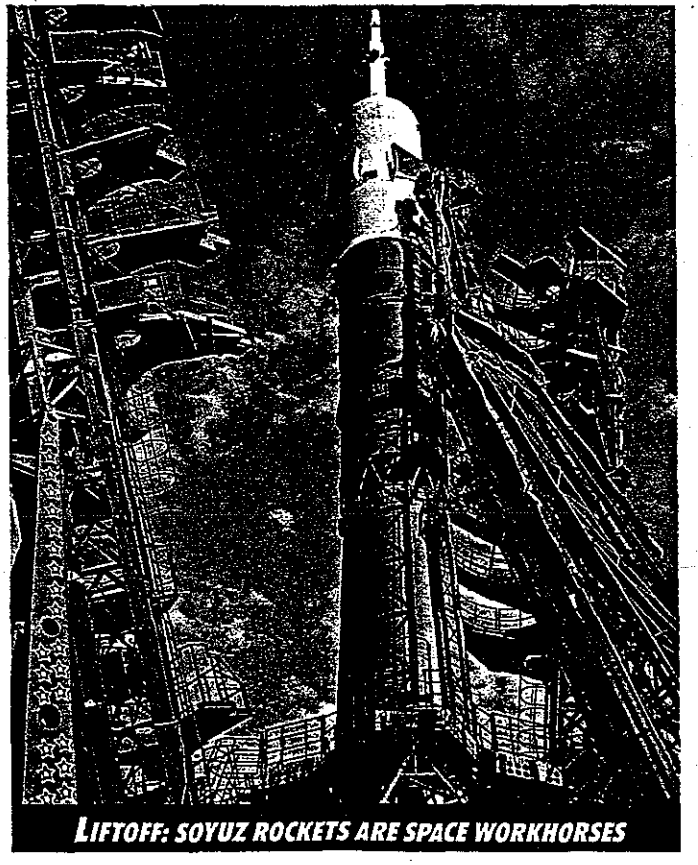
The scientific and technological potentials of the two countries are great. This creates a basis for a more vigorous economic cooperation on the basis of license trade. To date, 52 export license agreements and the same number of import license agreements have been concluded by Licensintorg with American firms.

At the same time the current sanctions and restrictions applied to the technology exchange between the USSR and the U.S.A. adversely impact the development of business with American companies on a really large scale.

Difficulties may arise from time to time, of course, in such a complex matter as licensing trade. We are convinced that they can be resolved by means of a patient dialogue and bringing together the positions of those interested in the solution.

NEXT

SOVIET TECHNOLOGY



LIFTOFF: SOYUZ ROCKETS ARE SPACE WORKHORSES

NOVOSTI

In the heart of Moscow, not far from Red Square, up the long circular drive lined with waiting Chaika limousines and past the baroque fountain, stands a palatial building dating from the days of Catherine the Great. Inside, down corridors carpeted with Oriental rugs and lined with ornate mirrors, are the spacious offices of the bureaucrats who head the Soviet Academy of Sciences. For 50 years this elite has quietly presided over the long, slow decline of Soviet science and technology.

Today the Soviet Union is an oddly backward superpower. It boasts the world's largest scientific work force and many of the finest mathematicians and theoretical physicists. Yet it has won only a handful of Nobel prizes. Since 1986, a manned Soviet space station has orbited above the earth, and now there is a space shuttle to service it. The first manned mission to Mars is being planned. But with their creaky phone system, Soviet citizens can barely call home crosstown, much less transmit computer data reliably. The nation builds hydrogen bombs but cannot supply its hospitals with cotton swabs and syringes.

'DEEP WOUNDS.' "During the past half-century, Soviet science has suffered deep and still bleeding wounds from ill-conceived government policies," Roald Z. Sagdeev, director of the Soviet space program, recently complained in a scathing attack on Soviet technology published in an American science journal. Indeed, the Soviet Union has missed out on the revolutions in biotechnology and computers, key components of economic growth in the late 20th and early 21st centuries.

No bureaucratic miscalculation cut deeper than one made in 1962. "There was a government decision to completely cancel the computer division in the Academy of Sciences," says Yevgeny P. Velikhov, vice-president of the academy. Now the Soviet Union can't mass-produce a personal computer, let alone advanced scientific instruments or computerized controllers for factory machinery. There are only about 200,000 personal computers in the entire country. Its fastest machines lag far behind the

THE SOVIET UNION MISSED OUT ON THE REVOLUTIONS IN COMPUTERS AND BIOTECHNOLOGY. WITH GORBACHEV DETERMINED TO CATCH UP, HOW MUCH SHOULD THE WEST HELP OUT?



LETDOWN: MUSCOVITES HAVE TROUBLE MAKING CALLS

MEYER/BLACK STAR

supercomputers from such manufacturers as Cray Research Inc. and Fujitsu Ltd. And its semiconductor industry makes only 3% of the world's chips. "It's shocking how far behind they are," says Loren R. Graham, a specialist on Soviet science and technology at Massachusetts Institute of Technology.

Yet advanced technology is crucial to Soviet leader Mikhail S. Gorbachev's plan to restructure the economy. His policy of *perestroika* is essentially geared toward pushing the Soviet Union into the late 20th century. "Our economy is too energy-consuming, too labor-consuming, too material-consuming," admits Lev A. Bogdanov, who heads applied physics research at the Soviet academy. "All this must be changed."

Already, Bogdanov and other academy officials at 14 Leninsky Prospekt are on a forced march to close the technology gap. In a sweeping reorganization of its leadership in mid-October, 20 top scientists were retired. That move, confesses academy President Guri I. Marchuk, chopped the average age of the leadership by 20 years.

LOOSENING UP. But that was only the beginning. Now research funds will be controlled by boards of scientists who will evaluate the merit of experiments—as in the West—instead of being handed to the powerful heads of the Soviet Union's major scientific institutes to dole out as they see fit. In addition, Gorbachev is trying to spur innovation by creating some competition for the country's staid state-owned manufacturers. He is encouraging Soviet-style high-tech startups and establishing what are basically venture-capital banks.

Meanwhile, Soviet scientists and engineers have been dispatched on a shopping tour of the West. They have been showing up lately at computer and software companies and at trade shows for industries ranging from machine tools to aerospace. Besides renewing scientific contacts forged in the détente era of the 1970s but largely cut off after the invasion of Afghanistan, they are trying to license technology, gain management expertise, and set up

THE HOTTEST SOVIET CLUBS HAVE HARDWARE INSTEAD OF HEAVY METAL



AT CLUB DISC, KIDS LEARN BASIC PROGRAMMING—AND PLAY VIDEO GAMES

HIGON/SYGMA

In a back-street office, just around the corner from the imposing apartment building where Soviet leaders Leonid I. Brezhnev and Yuri V. Andropov once lived, Vladimir P. Schwartz scratches on a blackboard. Twelve sets of eyes follow his fingers. "Now you write down, 'Line 10: Let A=3,'" he tells his class. Little beeps fill the room as the students tap the program into Soviet-made computer keyboards plugged into television sets on their desks. "This is a dream for me," says Elena Inozemsteva, a dark-haired, 35-year-old electrical engineer.

Welcome to Club Disc. Inozemsteva founded the Moscow computer club a year ago so that adults and kids alike could enjoy the rare experience of programming actual computers. Although more and more Soviet schools now teach computer programming through books, most would-be Soviet hackers don't have access to the real thing. There are only 200,000 personal computers in the Soviet Union. Even the primitive Beka-0010s are nearly impossible to buy in state stores.

Club Disc's membership has grown to 262 in the past year, and the club now boasts three locations. "This center will liquidate computer illiteracy," predicts Inozemsteva. It will get help from 20 similar clubs, all cooperatives owned by groups of Soviets, that have sprung up around Moscow.

During the 12 hours a day it is open, Club Disc is constantly busy. Members sign up for six-week courses of biweekly classes in the Basic computer language. Basic is all the Beka-0010, the only personal computer the Soviets have managed to produce so far, can handle. Adults pay 50 rubles—about $85—for the classes, with teenagers and children paying half-price. The club uses the funds for salaries and hardware. "We have students from very different backgrounds," says the 58-year-old Schwartz. "Very few people are here because their job requires it."

TREASURE HUNT. Vladimir, a middle-aged student, joined Club Disc so that he can teach computing to his two daughters. "I'll buy a personal computer when they become less expensive," he says. Adds Aleksei, a 26-year-old student: "When I was in school, computer training was nonexistent."

Inozemsteva's prize pupil is Sergei, 21, who recently got out of the army. He's well-versed in Basic and Fortran, studies engineering at the Transportation Institute, and acts as a handyman for the cooperative. "There are not so many clubs where you can come anytime you want," he says. "If it were possible, I'd live here."

Not everyone takes Club Disc so seriously. For children, it's part school, part video game parlor. After learning how to program games, kids can come back, pay a ruble, and play them for 45 minutes. On this day, Treasure Hunt mesmerizes 13-year-old Janna. "This is my first time here," he says, eyes glued to the screen. "I heard about it from my sister." Like many a Western teenager, he adds: "I really don't care that much about computers, but I do like the games."

By Peter Galuszka in Moscow

joint ventures with Western companies. They are also peddling Soviet machine tools, computer software and other technology abroad.

Western businessmen are flocking to Moscow (BW—Oct. 31). Fiat Chairman Giovanni Agnelli wants to help the Soviets double their auto production. William C. Norris, former chairman of Control Data Corp., wants to start an American-style business school in Moscow and set up a venture to license Soviet technology in the U. S. Six American corporate giants—Eastman Kodak, Ford, Johnson & Johnson, Chevron, RJR Nabisco, and Archer Daniels Midland—have a consortium to establish joint ventures with the Soviets. A West European group recently signed a deal to build a nuclear power plant in the Soviet Union, which has put its own program on hold after the disaster at Chernobyl.

DILEMMA. The sudden surge of East-West technology transfer is sparking new debate over a long-standing dilemma—does the West want a thin, hungry Russian bear or a fat, healthy one? Many U. S. hardliners argue that the latest Soviet effort is nothing more than an attempt to obtain badly needed Western technology for its military.

The Europeans don't agree. Since last spring, European banks and governments have inked more than $4 billion in credits to finance trade with the Soviets. Italy's Olivetti just signed a deal to build a $285 million factory near Leningrad to produce machine-tool controllers. On Oct. 24, West German Chancellor Helmut Kohl led 40 executives to Moscow, where they negotiated ventures on a wide range of technologies, including nuclear power plants, machine tools, pollution-control equipment, and industrial robots. "It is in our own interests to have a modern and open Soviet society," says a top German trade official.

For now, the U. S. government is still not encouraging broader U. S.-Soviet technology trade. In the mid-1980s, cold warriors Richard N. Perle and Stephen D. Bryen at the Defense Dept. led a Reagan Administration campaign for much tighter restrictions. In the name of national security, they pushed to ban exports of products such as Apple II computers and video games and even closed some U. S. scientific meetings to foreigners. But both have left the Administration.

Export-control regulations have since eased to permit exports of higher-performance computers such as IBM PC/ATs. Although the next Adminstration may relax controls further, the U. S. still maintains controls more stringent than those of the Western allies. Commerce has ruled out allowing U. S. companies

to build plants for small computers in communist countries—on the grounds that that would violate national security. "The Soviets haven't changed their military posture," says Commerce Under Secretary Paul Freedenberg.

HOG-TIED? Many U.S. executives complain that Washington's stance hands the advantage to the Europeans and the Japanese. Cummins Engine Co., for example, is negotiating a joint venture to build a diesel engine plant in the Soviet Union. "Our biggest stumbling block probably is Washington and the technology-export controls," says John L. Becker, director of business development for Cummins. "That hands the business directly to our Western allies."

To the Pentagon, the threat to national security overrides the potential for profits. Not only do the Soviets build MIG-29 fighters, Kalashnikov rifles, and lethal SS-24 and SS-25 mobile missiles, but so far they also are the only nation to have built a titanium-hulled submarine, the Alfa class, which can dive deeper and run faster than U.S. subs. And Western military officials say the Soviets are developing antimissile lasers at a defense complex in Sary Shagan in Central Asia.

In the Soviet Union the military has always gotten the best of everything—even at the risk of serious shortages of domestic goods, including food. Despite all the attention to *glasnost* and *perestroika,* there is no evidence that Gorbachev has cut military spending. And the Soviet military has a long history of doing whatever it deems necessary to get advanced foreign technology.

Russia's first atomic bomb was built with the help of secrets stolen from the West. Although there are important differences in design, the new Soviet space shuttle, intended to service the Soviet Mir space station, looks strikingly like those built by NASA.

Without doubt, the Soviets traffic freely in stolen technology. In 1987, Soviet contraband included sophisticated Toshiba Machine Co. milling machines. In 1985, Wolfgang Lachmann, a Munich entrepreneur, diverted $11 million worth of computer workstations made by Tektronix Inc., in Beaverton, Ore., and disk drives made by Control Data Corp. to the Soviets. When the Soviets get such gear, they are notorious for "reverse engineering" it, working backward to copy the design. A few years ago, Intel Corp. executives were appalled to find even nonfunctional details left by a designer precisely copied on a Soviet chip.

LASER MIRRORS. Some U.S. experts see signs the Soviets are now determined to acquire such high-tech items as advanced microelectronics, side-scan sonar for submarines, and laser mirrors, which could be a key component in Star Wars systems. In the recent shake-up of the top Kremlin leadership, foreign-intelligence expert Vladimir A. Kryuchkov was elevated to KGB chief, over Viktor M. Chebrikov, a sign to most Kremlin watchers that the KGB is putting less emphasis on controlling internal dissent and more on foreign-intelligence activities—especially tracking and acquiring technologies.

Publicly, at least, the Soviets claim to have had a change of heart. On a recent visit to Wang Laboratories Inc., Micropro International Corp., and other U.S. computer companies, a group of Soviet computer experts insisted that they would go through proper channels. Said Anatoly A. Stogny, chairman of the Soviet academy's commission on data banks: "We have come over, in part, to say that we are prepared to establish honest commercial relationships with the same companies whose products we have been using on an illegal basis."

Many U.S. businessmen believe that the benefits of sharing technology outweigh the pitfalls. One is Control Data's Norris: "Cooperation in science and technology could have an enormously rewarding outcome for both countries. There are many people in the U.S. who say: 'To hell with helping them straighten out their mess—it would only get used against us.' I don't buy that at all."

Even if the West cooperates, Gorbachev faces an enormous battle at home. His backward, centrally planned economy is ill-suited to keeping up with fast-moving, innovative industries. And Soviet workers have long been accustomed to taking orders from the top rather than responding to incentives and taking risks. "They do best in gigantic state-run programs" such as space exploration, says MIT's Graham. "They do worst in those areas where market pull and private enterprise are the moving forces."

The Soviet failure in computers is a prime example. In the 1950s and early 1960s, when computing was largely a military pursuit, the Soviets were closer to the cutting edge. But when the commercial market in the U.S. became its most dynamic sector, Soviet central planners cooled off. In the hands of the public, computers were

SHOPPING FOR TECHNOLOGY IN THE WEST

The Soviets have signed, or are hoping to secure, a variety of deals that would give them access to Western technology. The following are some of the more important ones:

AEROSPACE Discussing venture to upgrade aircraft production plants and develop engines with West Germany's Messerschmitt-Bölkow-Blohm

COMPUTERS Setting up joint ventures to import and assemble IBM-compatible personal computers in Soviet Union with European and U.S. companies, including Innovation International and Management Partnerships International

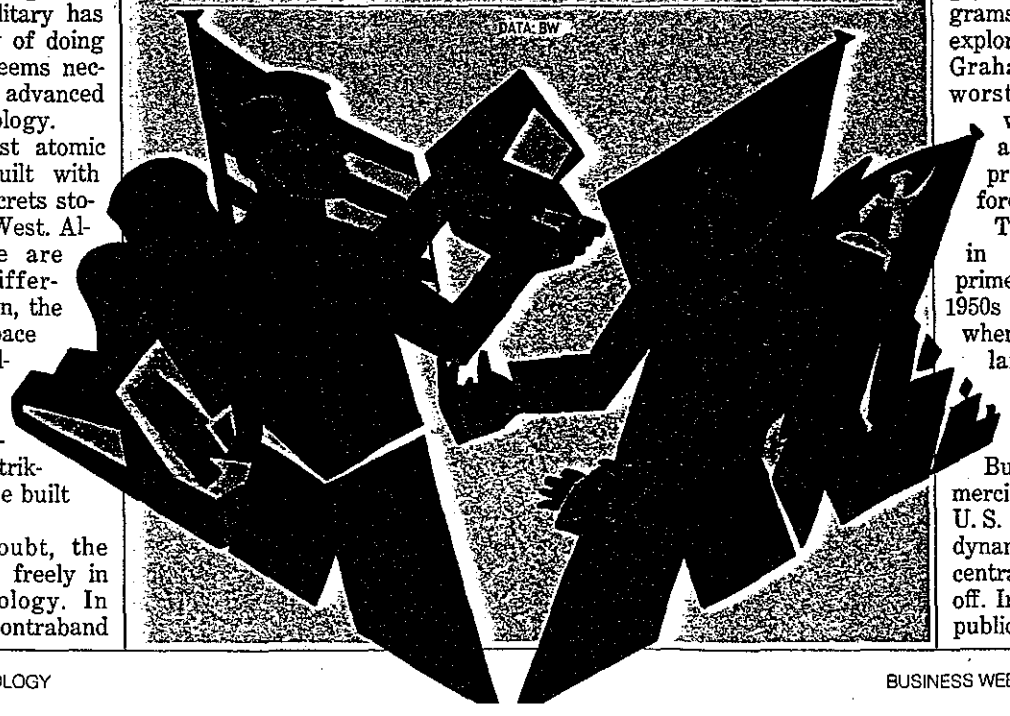
MANUFACTURING Acquired process control systems through joint ventures with Combustion Engineering and Honeywell. Hired West Germany's Siemens to automate medical equipment production. Discussing numerous machine tool ventures

NUCLEAR POWER Set up joint venture with Asea, Brown Boveri, and Siemens to build nuclear reactor. Hired Siemens to upgrade nuclear power plants

SEMICONDUCTORS Seeking U.S. and European partners to manufacture semiconductors designed by Soviet engineers

TELECOMMUNICATIONS Launched joint venture to make telecommunications cable with Finland's Nokia; buying digital switches from European and Canadian suppliers

DATA: BW



CHRIS SHARP

a direct threat to police-state control over information and communications. "When the information era dawned, no one in the Soviet Union wanted the transparency it was designed to bring," says Henrik Bischof, an East bloc specialist at the Friedrich Ebert Foundation in Bonn.

STODGINESS. Today, the Soviets simply don't have what it takes to compete. Japanese and U. S. semiconductor companies have shrunk the size of electronic elements to less than one micron. The Soviets say their best chips use 1.8 micron lithography. They have yet to build 32-bit personal computers, which are becoming common in industry and laboratories in the West. The best Soviet memory chips can hold 256,000 pieces of data, while Japan and the U. S. routinely make chips of megabit (1 million-bit) capacity and are producing prototypical 4-megabit chips.

The upshot is that Soviet scientists must wait days for a chance to use the few state-of-the-art instruments that have been scrounged from the West (page 82). In industry, that same technology is critical to manufacturing semiconductors and building computers. "The main problem for us is the infrastructure, such as very clean materials, components, production equipment," says the Soviet academy's Velikhov, a chunky, gregarious scientist whom Gorbachev picked to head a crash program to close the computer gap.

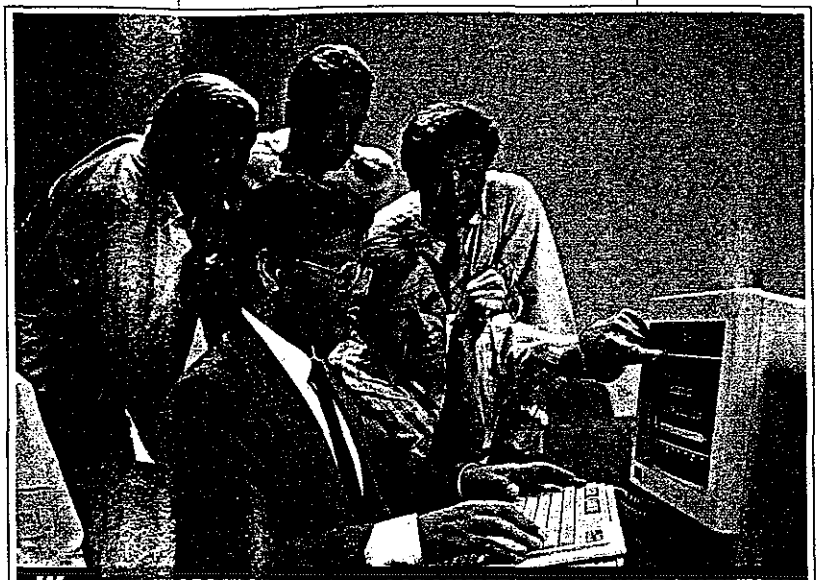
So even though Gorbachev is gambling that undoing the economic damage caused by the computer fiasco is worth the political risks of wider use of the machines, it will be a long time before computers are widespread. Velikhov displays a bumper sticker in his office at the academy that reads "Computers for Everyone," and computer-user clubs (page 70) and desktop publishing are becoming more common. But the Soviet effort to produce a million personal computers a year by 1990 is not likely to succeed. "I'm afraid we will not fulfill this goal," he says.

SHOCKING PROPOSALS. Some Soviet scientists don't want to wait for the national computer industry to catch up, however. A group of scientists visiting the U. S. said they wanted American companies to manufacture Soviet-designed chips and a Soviet-designed 32-bit microprocessor for factory automation systems—a move that would surely trip alarms in the Pentagon and on Capitol Hill. "From the architectural or system point of view, we have very interesting designs now," said Boris V. Batalov, head of the Research Institute for Computer-Aided Design at the Soviet academy. "We don't want to wait for Soviet mass production." The Soviets broached the plan at a Commerce Dept. meeting in August, but U. S. officials were unenthusiastic. No American semiconductor firm admits having discussed the idea.

This is not the first time the Soviets turn to the U. S. In the early 1920s, shortly after the Russian Revolution, Lenin did the same. Sixty years ago, Henry Ford built a huge automobile plant in the Soviet Union, and U. S. companies built steel plants and oil refineries.

But the Soviets haven't always made the best use of the technology they acquired. In the 1960s and 1970s, they bought turnkey factories, such as an auto plant built by Fiat in Togliatti. By the time the bureaucracy got the plant running, it was outdated. That's why the best-selling 1987 Soviet Zhiguli autos look an awful lot like 1972 Fiats.

Gorbachev's current push for joint ventures is different. He wants not just machine tools and computers, but the manufacturing and management skills needed to produce high-technology goods. Says Seymour E. Goodman, professor of management information systems at the University of Arizona: "The Soviets seem to have learned the lessons of the 1970s. They don't just want to purchase technology. They want to be taught how to do things."



KEN KERBS

WESTERN SHOPPING TRIP: A PROGRAMMER GIVES SOVIET SCIENTISTS A SOFTWARE DEMONSTRATION AT DATAEASE IN TRUMBULL, CONN.

The Soviets have already signed several computer and software joint ventures with U. S. companies. Dialog, a venture between Management Partnerships International in Chicago, the Soviet Kamaz Truck Plant, Moscow State University, and other partners, plans to ship subcomponents of personal computers to Moscow and sell Soviet-designed software in the West.

In Kiev, academician Stogny heads a team of programmers developing a computer network and a data base for the city managers. He wants to buy IBM clones from Malaysia and Taiwan and will finance the effort through a joint venture with DataEase International Inc., a Trumbull (Conn.) software firm that will sell data-base software.

But Soviet software may not fare well in the already crowded American marketplace. So Innovation International Inc., a Boston-based computer company, has a different approach: it plans to ship 3,000 IBM PC/XT clones next year to Moscow and eventually hopes to set up a computer manufacturing plant there.

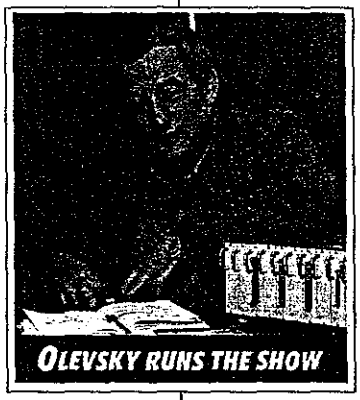
The Soviets have better luck selling heavy industrial technology abroad. Some U. S. companies have even been based on Soviet technology. New Jersey-based Multi-Arc Scientific Coatings, for example, bought the rights to a Soviet process for putting hard titanium nitride coatings on cutting tools. And Bering Co. in San Francisco is selling Soviet-designed hydroelectric turbines.

FREE LAUNCH. The Soviets are trying to earn Western cash with their space program, too. Glavkosmos, the commercial arm of the Soviet program, is working with Houston-based Space Commerce Corp. to line up U. S. customers. RCA, Ford Aerospace, and Hughes Aircraft have looked into lofting their satellites aboard Soviet rockets. At about $30 million a shot, the launch is cheaper than either NASA's prices or the European Ariane program. But so far the U. S. has denied them permission.

No matter how much the Soviets buy and sell, they will not catch up in the technology race until they rebuild their industrial base. Some joint ventures may help. Connecticut-based Combustion Engineering Inc. is installing process controls at refineries, for example. But cur-

STEP ONE FOR THE ENTREPRENEUR: GO CO-OP

Sergei Olevsky never thought he would end up running a high-tech startup. A researcher at a Moscow microelectronics institute for 10 years, Olevsky lost his job in 1981 after becoming involved with an international scientists-for-peace group. That earned him six years as a laborer in a welding factory. But after Soviet leader Mikhail S. Gorbachev advocated small cooperatives owned by groups of individuals, Olevsky's luck turned. First, he joined a cooperative making experimental superconducting materials. Just a few months ago, he set out on his own.



OLEVSKY RUNS THE SHOW

Olevsky founded Iskatel, a cooperative that makes controls that connect Soviet-made personal computers to automated factory machines. He led a group of engineers to design the devices and now oversees a work force of 250. Since production started in June, Iskatel has made 80 such links a month and has lined up a dozen steady Soviet customers. The company expects to be producing 8,000 controls a year by 1990. To earn the hard cash it needs to purchase supplies abroad, Iskatel also makes gold and silver jewelry, small handbags, and other goods.

Cooperatives are a key element in Gorbachev's push to restructure the Soviet economy, from agriculture to technology. By the year 2000, Olevsky predicts, high-tech co-ops will represent as much as 25% to 30% of domestic Soviet trade. Already, 32,000 co-ops are scattered throughout the Soviet Union, including restaurants, auto repair shops, and a few ventures such as Iskatel. Gorbachev hopes the technical co-ops will break down research bottlenecks by speeding up decisions, spending less on overhead, and paying their workers more.

MOONLIGHTING. Like many startups outside the Soviet Union, Iskatel designed a product to fill a market niche. "Our task was to create a safe, inexpensive device," Olevsky explains. With the big push to automate factories and farms, Soviet managers have been looking for lower-cost controls that would allow Soviet-built Beka-0010 personal computers to control machinery. Until Iskatel brought out its product, the only available Soviet interfaces cost as much as $136,000 because they had been designed to help run nuclear power plants. Iskatel's three interface models are priced from $10,000 to $42,500. The Beka-0010 personal computers cost a mere $1,100.

Iskatel got its interfaces into production in just three months. Left to more traditional institutes, such an effort "would never get done," Olevsky says. The cooperative keeps bureaucracy to a minimum. Of its employees, "we have only three people who are not producing," says Olevsky. In other Soviet enterprises of the same size, he adds, "there can be 50 to 70" nonproduction people. Iskatel pays its full-time workers an average of $850 a month, double the typical Soviet worker's wage. Top researchers and managers make up to $1,700 per month, almost three times the amount Soviet institutes pay their scientists.

For now, Iskatel relies largely on a makeshift work force: Most employees are moonlighters who hold full-time day jobs. Still, Olevsky says sales will hit $34 million in Iskatel's first year—50% from electronic systems.

The co-op now assembles the interfaces in three different shops. Eventually, Olevsky hopes to build a factory and hire full-time workers. He's also trying to woo a U.S. company into forming a joint venture, and he plans to show off Iskatel gear in New York City in December. Iskatel will try to improve on the Soviet computers as well: It recently received from Europe its first batch of components to make IBM clones.

For all the success of cooperatives to date, their future is less than certain. Before they can become effective on a wide scale, public attitudes will have to change: Many Soviets still see such ventures as anticommunist. "The movement will come," predicts Olevsky. "In three to five years, there will be a change of ideological thinking." If that happens, cooperatives could do what centrally planned Soviet ministries have failed to accomplish: propel Soviet technology out of labs and onto the factory floor.

By Peter Galuszka in Moscow

rent Soviet industrial quality is shoddy. A third of the apartment fires in Moscow last year were blamed on Soviet-built TV sets, which tend to explode if left on too long. The labels on most soft-drink bottles are crooked. "The inefficiency of their work force is incomprehensible," says Ulrich Albrecht of the Otto Suhr Institute of the Free University in Berlin. "They require an education process that will take decades."

That will be a daunting task. But Gorbachev has taken up the challenge. Throughout Soviet industry, factories are experimenting with ways to improve incentives for workers. In some plants, managers encourage workers to group together in teams and pay higher bonuses if production beats quality standards. Recently, Gorbachev proposed that workers be allowed to lease parts of factories and run them for their own profit.

Now the Soviet Union boasts startups of its own in the form of new cooperatives. Individuals were first allowed to pool their resources and set up jointly owned companies last year. Now several scientific cooperatives are getting under way (box). At Tartu University in Estonia, the Estonian Bio Center has spun off several co-ops that are developing biotech products.

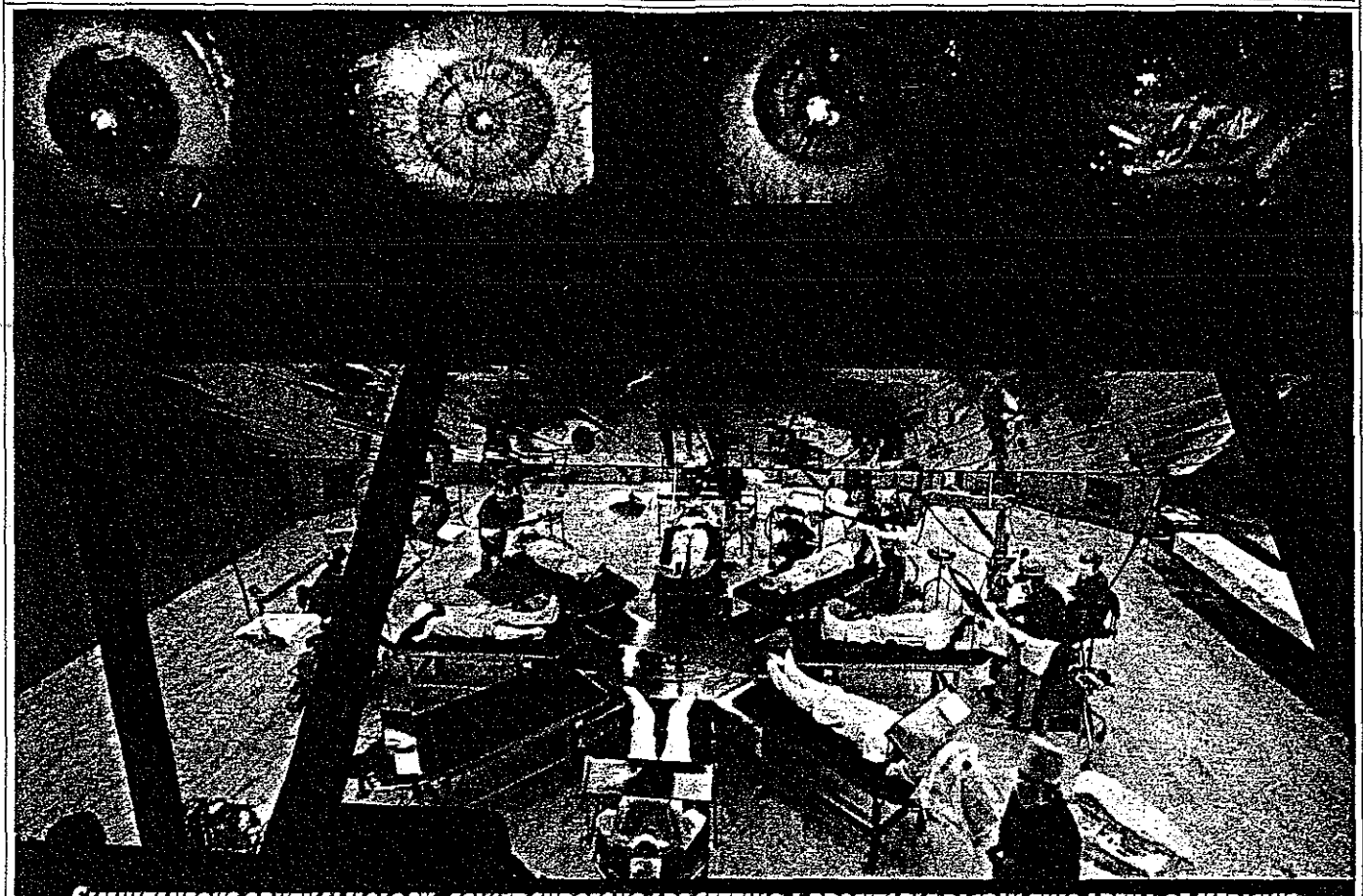
INNOVATION BANKS. To cut red tape and deliver funding faster, the Soviets are creating a network of Innovation Banks. Akin to Western venture-capital outfits, the banks are aimed at providing startup capital for new cooperatives. They also will fund scientific research not supported by research institutes and ministries.

Under the scheme, scientists can hope to earn thousands of rubles for an invention, rather than the typical onetime fee paid by state institutes and ministries—equivalent to just $300. "The main feature is to give people an interest in their work," says Vladimir Semoyonov, who has eight phones beside his desk, which is a sign of his status as head of the Leningrad Innovation Bank's council of shareholders.

Still, it remains to be seen whether the Soviets can graft Western-style incentives onto what is still a centrally planned economy. And the Soviets are trying to chase a moving target. "They are getting better all the time," says MIT's Graham, "but we have been getting better faster." With the remarkable changes under way, however, the momentum is clearly building for much broader East-West technology exchange. That will mean new opportunities—and fresh dangers—for both sides.

By Peter Galuszka in Moscow and William D. Marbach and Rose Brady in New York, with Bill Javetski in Washington, Gail Schares in Bonn, and bureau reports

ROBERT D. TOWNSING/WHITE TIGER



SIMULTANEOUS OPHTHALMOLOGY: SOVIET SURGEONS ARE SETTING A PROFITABLE PACE IN THIS ARENA OF MEDICINE

PHOTOGRAPH BY RODIONOV/NOVOSTI

WHAT WILL THEY DO WHEN THEY GET THE RIGHT STUFF?

Soviet scientists use old equipment, have few computers—but make some big discoveries

It's time to celebrate at Laboratory Building A in the forested park that surrounds Moscow State University. Pavel Dibrov, a pudgy, 30-year-old biophysicist, helps arrange the rich chocolate cake amid test tubes and teacups on a table. "This is a tradition," he says, as his colleague Marina, whose birthday it is, grins.

But Pavel and Marina's jobs as university researchers are hardly a piece of cake. While some top scientists enjoy relative luxury, including limousines, spacious apartments, and foreign travel privileges, the average Soviet researcher scrapes by on 185 rubles a month. At about $315, that is less than a truck driver or a hairdresser earns.

Military labs and institutes run by the Soviet Academy of Sciences have first claim to hard-won foreign laboratory equipment. University scientists like Dibrov use instruments that might be found in a Western high school. Chemicals are in such short supply that he and his team must plan experiments 12 to 18 months in advance.

POOR BUT PROUD. Still, Dibrov and other Soviet scientists manage to get some work done. A specialist in the transfer of energy between cells in the body, Dibrov discovered an enzyme that might lead to new drugs and applications in biotechnology and agriculture.

Indeed, the Soviet Union has a brilliant—and stubborn—scientific tradition. Soviet chemist Dmitri Mendeleev gave the world the periodic table of the elements, and Ivan Pavlov provided key clues to behavior. Soviet scientists were the first to put a satellite in space and a man in orbit. They managed to explode their first atomic bomb only four years after Hiroshima, even though their country had been devastated by war.

Despite isolation and the police-state secrecy of the Cold War years, the art of innovation survived. Soviet mathematicians and physicists are world-renowned. They did early theoretical work on computers and are now writing software and designing chips, although most Soviet computers are small and years out of date.

Why didn't the oppression bring Soviet science to a complete halt? Dibrov and others believe that the shortage of state-of-the-art equipment and supplies and the isolation from other scientists drove the Soviets to find simpler, and often more elegant, solutions to problems. "We are poor," he says, "but we must use this to our advantage."

The ability of Soviet scientists to cut through to the nub of the matter has its admirers in the West. "In any area of science where good work can be done with a piece of chalk and a blackboard—the very theoretical, abstract, and highly mathematical areas—the Soviet Union is likely to be very, very good," says Loren R. Graham, an expert on Soviet science and technology at Massachusetts Institute of Technology.

Outsiders also say that Soviet scientists often benefit from their different approach. "They aren't thinking in a lockstep mode with Western scientists," observes Bernard P. O'Meara, executive vice-president of Kiser Research Inc. in Washington, a consulting firm that licenses Soviet technology to U. S. companies. "There is no place that is as scientifically and technically advanced as they are that is as unaffected by Western advances and market drives."

EYE-OPENING ADVANCES. The Soviets have made discoveries that are widely used in the West. They're leaders in such industrial technologies as metallurgy, for example. They invented continuous casting of steel and welding methods used to build pipelines and the rails for the Washington metro. A process for electromagnetic casting, developed in the 1960s, has been licensed to virtually every major aluminum company in the world. Now the Soviets are hoping to capitalize on the expertise of the Paton Welding Institute in Kiev. It has cooperative agreements with welding institutes in Britain and Columbus, Ohio.

Then there's ophthalmologist Svyatoslav Fyodorov. In a nation with notoriously poor medical care, he developed radial keratotomy, a surgical procedure to correct nearsightedness. And, at Moscow's Eye Clinic, he designed a surgery that looks more like mission control than an operating room.

Lying on beds arranged like the petals of a flower, five patients undergo surgery simultaneously. Viewing the eye via computerized imaging systems a surgeon makes tiny incisions on the eye to correct vision by changing the eyeball's shape. Fyodorov and his team perform 21,000 operations a year and plan to build other clinics. The surgical assembly line has brought fame and hefty revenues—including an estimated $1 million annually from foreigners.

Soviet scientist Vladimir Deryagin gave Western scientists another surprise. Working in a dusty lab crowded with old wooden desks at the Institute of Physical Chemistry in Moscow, he discovered a way to turn powdered carbon into films of diamond—at low temperatures. Those superhard crystalline layers have become the focus of a major development effort in the West. That's because they can be applied to tools and other metal parts and may lead to heat-resistant semiconductors. "Many applications in the U. S. and Japan will be based on this work," says Dmitri Fedoseev, who heads the lab.

STRAITJACKETED. Still, daunting handicaps have made Soviet accomplishments hard to come by. A staid bureaucracy at the Soviet Academy of Sciences determines the direction of research. Once assigned to a project, scientists are rarely allowed to follow their instincts into new avenues of inquiry. Nor are there market forces to dictate change.

The upshot is that Soviet technology has often stuck to preset paths—with disastrous consequences. From 1940 to 1965, Trofim D. Lysenko, who headed the Institute of Genetics, held sway with his theory that organisms can pass on acquired characteristics to succeeding generations. So modern genetics research halted, and the country missed out on the genetic revolution that spawned biotechnology. Similarly, a political decision not to pursue computers left the country on the sidelines.

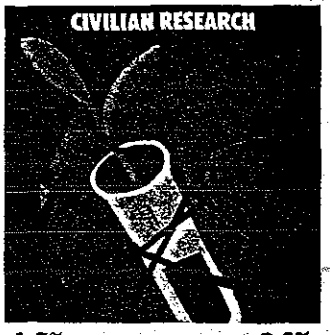
Bureaucracy and human-rights abuses also helped drive away many leading Soviet scientists—especially Jewish ones. A steady trickle has managed to get permission to leave. Some defected at scientific conferences, and many more refused to work after their requests to leave were denied. Although the West pressured the Soviets to release some of the most prominent refuseniks, such as computer expert Natan Scharansky, Western diplomats say many Soviet scientists are still waiting to emigrate.

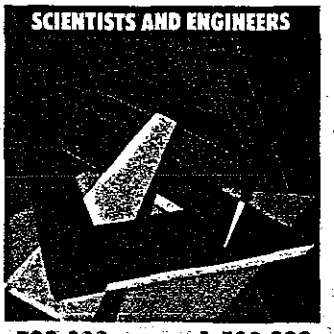
Such defections have hurt. Herman Branover was a key figure in the Soviets' massive effort to develop magnetohydrodynamics (MHD), a technology for generating electrical power that promises to be more efficient than the turbines now in use. He was allowed to leave the Soviet Union 16 years ago and now heads a project at Israel's Ben-Gurion University to work on a process he developed called liquid-metal MHD. And he's organizing an entire community, with research facilities and factories, to house other Soviet émigré scientists.

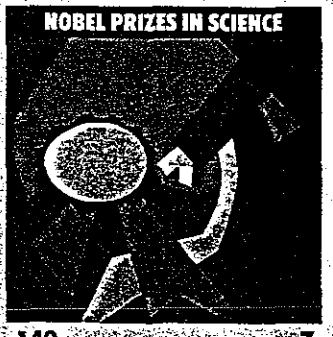
STEADY FUNDING. Branover does see something positive in the way the Soviets treat technology. Once they commit themselves to an advanced, long-range project, the funding is steady, year after year. "Now I spend half my time, maybe 80% even, looking for money," he says. In the Soviet Union, "I only had to fill out a short form once a year."

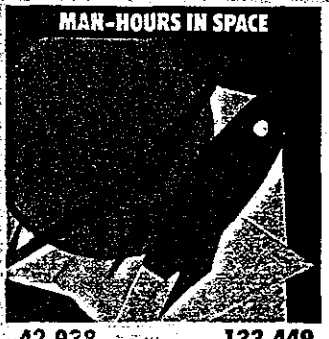
That helps explain why the Soviets are in the forefront in such slow-moving, costly areas as MHD, manned space, and fusion. They've been working on fusion research, for example, for 35

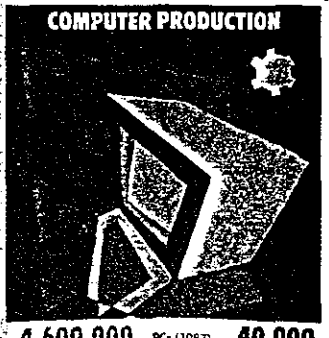
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DATA: CONGRESSIONAL RESEARCH SERVICE, PLANECON INC., NATIONAL SCIENCE BOARD, SOVIET GOVERNMENT, BW

CHRIS SHARP

years. At the high-security Kyrchatov Atomic Energy Institute in Moscow, workers in white lab coats are putting the finishing touches to an experimental fusion-power reactor called Tokamak 15. The $510 million device, which will use an intense magnetic field to fuse hydrogen atoms at 100 million degrees centigrade, is comparable with the most advanced installations in the West.

ROCKET RIDES. Similarly, the Soviet space program has relentlessly pushed ahead with 100 launches a year, both manned and unmanned. While a U.S. space station won't be in orbit until the mid-1990s at the earliest, the Soviets have manned their Mir space laboratory since 1986. Now the Soviets also have a reusable space shuttle, which looks curiously like those built by the U.S.

The Soviet Union has also taken a big-budget approach to modernizing its research base. In the 1960s it began constructing a "science city," called Akademgorodok, near Novosibirsk in Siberia. The idea was to make the city a center for research in physics, biochemistry, economics, and mathematics at a time when development of Siberia was a government priority. Although it has proved difficult to lure scientists so far from Moscow, many of Mikhail S. Gorbachev's key scientists, including Academy President Gury I. Marchuk, worked there.

Now Soviet planners are investing heavily to catch up in biotechnology. A vast, 13-building complex is rising in southwest Moscow, the $3.4 billion home of the Shemyakin Institute for Bioganic Chemistry. The buildings are connected by bridges, and the complex is patterned on the double-helix structure of DNA.

Unlike most Soviet laboratories, those in the institute are clean, well-lighted, and filled with the latest equipment—mostly American and other foreign-made gear. In one room centrifuges made by SmithKline-Beckman Corp. are lined up like washing machines in a laundromat. Apple Computer Inc. and IBM personal computers are scattered throughout the complex. "It was recognized that we were backward in modern biology. We had to do something," says institute Director Vadim Ivanov.

The institute is already conducting a broad range of biotechnology research, from agricultural projects to producing such drugs as interferon, interleukin-2, and human growth hormones. On a recent afternoon, a graduate student working on his PhD thesis was sitting at an IBM clone with an optical disk attached. He could call up 7,000 protein sequences and 15,000 nucleic acid sequences from a data base, DNA-Star, that was written in the U.S.



RESEARCHER DIBROV MUST PLAN EXPERIMENTS MONTHS IN ADVANCE

For now, however, only a handful of Soviet scientists work in such showplace labs. Many more struggle in older research institutes that remain heavily bureaucratic. Top-echelon scientists are generally deeply conservative. "They see themselves as slaves of the authorities," says Yury Khronopulo, a specialist in laser physics and nonlinear optics who left the Soviet Union in April and now lives in a growing émigré community in Brooklyn, N.Y.

Laboratories are still adorned with simplistic propaganda slogans, such as "All Glory to Soviet Science!" Young Soviet researchers are no longer vetted politically by Komsomol, the young Communist league, but they must still pass courses in Marxist-Leninist theory and the history of the Communist Party to qualify for a job. Getting funding and access to modern equipment is still extremely difficult. "The only way is to attract the attention of the army," says Khronopulo. "The labs with no contacts with defense are beggars."



THE SOVIET SHUTTLE WILL BE A FERRY FOR COSMONAUTS

Under Gorbachev's *glasnost*, however, there are signs of change. The Soviet leader recently gave a very visible sign that he wants to ease travel restrictions on scientists. In November, Andrei D. Sakharov, the physicist and human-rights activist who was exiled to the city of Gorky from 1980 to 1986, will be allowed to travel to Washington. In addition, Sakharov was recently elevated to the 47-member presidium, or governing body, of the Academy of Sciences—the very body that condemned him as a pawn in the Cold War five years ago.

Soviet scientists are also becoming more openly critical of the way research is conducted. "We have revised policies to strengthen the connection between science and practice," wrote Soviet space program chief Roald Z. Sagdeev in a critical analysis of Soviet science published last summer. "But though such reforms may be necessary, we have not faced up to the real problem: Soviet fundamental science is too weak to contribute much to practical applications."

Even top Soviet officials are acknowledging the problem. Addressing a Communist Party conference in Moscow last June, Academy President Marchuk said: "Our potential for fundamental research is approximately five times lower than the U.S.'s." He pointed out that the U.S. spends about $15 billion a year on basic research, as opposed to the approximately $3.3 billion spent in the Soviet Union.

Without more open scientific communication, greater freedom to shift research priorities, more exchange with scientists around the globe, and better channels to industry so that ideas can translate into products, the Soviet Union will gain little. Even though more research facilities will be patterned after Shemyakin, it is likely to be a long time before researchers such as Dibrov have modern equipment. Meanwhile, the brain drain continues. There may be signs of spring, but the long winter of Soviet science isn't over yet.

By Peter Galuszka in Moscow, with William D. Marbach and Rose Brady in New York

PHOTOGRAPHS BY (TOP-BOTTOM) RODIONOV/NOVOSTI; TASS/SOVFOTO

NEXT

Report on a National Science Foundation Workshop on Intellectual Property Rights in Industry-University Cooperative Research

by

National Science Foundation
Office of the General Counsel
27 April 1981

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CHAPTER I

INTRODUCTION

On 27 April 1981, the National Science Foundation hosted a one-day Workshop on Intellectual Property Rights in Industry-University Cooperative Research.

The purpose of the workshop was to find out whether intellectual property issues were inhibiting cooperative research and, if so, how. The intent was to identify problems that require further study or corrective action—even if not necessarily by the NSF.

The workshop included participants from business, academia, and Government. An attempt was made to obtain a cross-section of opinion in each of these three sectors by inviting persons from a variety of positions within representative organizations. Attendees are listed in Appendix A.

This report summarizes the five major topics discussed:

- Benefits and dangers of cooperative research,
- Cooperative research and intellectual property rights,
- Trade secrets and proprietary information,
- Patent rights,
- Solutions and further actions.

CHAPTER II

BENEFITS AND DANGERS OF COOPERATIVE RESEARCH

Underlying the workshop was an implicit assumption that cooperative research should be encouraged. This reflected both the policy of the NSF and the personal judgment of the workshop planners. Since the participants were selected partly for their known interest in and experience with cooperative research, most, if not all, approved that policy and shared that judgment. However, comments of participants several times raised dangers and drawbacks of cooperative research as well as opportunities for universities, firms, and the research community.

A. Reasons for undertaking cooperative research

One university representative declared that industry-university cooperation, or "coupling", is an essential part of the technology transfer process. Universities and firms must attempt to move the latest scientific discoveries from campus laboratories to the production line if America's productivity and balance of payments difficulties are to be solved. He also noted that cooperative research is vital for engineering and applied sciences because feedback from industry helps to establish both research direction and educational emphasis. Several academic participants commented that reduced Federal spending is forcing universities to find other support for research. University researchers and administrators must seek funds from industry for the same reason Willie Sutton robbed banks: "Because that's where the money is."

One business participant opined that much cooperation between individual faculty members and firms takes place without the knowledge of the universities. Cooperative research programs merely formalize and control an inevitable phenomenon.

B. Dangers of cooperative research

Among the doubts and misgivings expressed were those of one academic participant who was concerned about the effect of interactions between highly-structured business (which he termed "crystalline") and largely unstructured university research departments ("liquid" or, jokingly, "gaseous"). He feared cooperative research might adversely affect the focus and functioning of academic researchers.

Participants from all three sectors worried that industrial support could pervert universities' priorities, channeling research into areas that produce short-term profits from those that advance scientific knowledge. In particular, some fear that Federal budget cuts will cause a "gold rush" towards industrial sponsorship, particularly by smaller or less-prestigious universities. This might trigger a "race to the bottom", as universities compete for industrial support by compromising their principles. One academic research administrator said that such pressures are already great at smaller universities. An industrial participant noted that academia cannot rely upon the generosity of strangers to save them. If a university offers its birthright for a mess of pottage, a business firm will take the bargain.

According to one university researcher, cooperative research projects should be on the basic end of the research spectrum. Firms should come to universities not for answers to specific problems, but for knowledge to cure deep ignorance. An industrial participant agreed that cooperative projects should focus on basic research, the traditional province of campus researchers, rather than applied research or development, the main concern of firms' "in-house" researchers. He said that applied research and development are naturally more likely to produce results that have immediate commercial significance and that consequently firms want to impose greater restrictions on applied research and developmental projects. He noted that universities must expect to incur "in-house"-type

restrictions if they seek to perform "in-house"-type research.

A representative from a public university said that universities, both state-chartered and private nonprofit, have to carefully avoid going into the research "business" for practical as well as philosophical reasons. He identified Federal tax problems and conflicts with small research companies as possible results of increased university involvement with applied research or development.

C. Consensus

The consensus of the participants was that cooperative research—on the whole, at its present volume, and as currently conducted—is clearly good for both universities and industry. Cooperative research, however, is not without its dangers, which may be exponentially related to the volume of cooperative research or the proportion of cooperative research to total university research.

CHAPTER III

COOPERATIVE RESEARCH AND INTELLECTUAL PROPERTY RIGHTS

A. Intellectual property rights matters inhibit cooperative research

The participants agreed that intellectual property rights sometimes prove a stumbling block to industry-university cooperative research. A research administrator noted that in the industrial Northeast less than four percent of academic research was industrially sponsored. He said that time and again during cooperative research negotiations, at meetings of governmental commissions, and in private discussions with businessmen, patents were given as the reason firms do not sponsor more on-campus research. Others echoed this observation, although the thought was expressed that intellectual property problems might occasionally be more excuse than reason for failing to undertake cooperative research.

All agreed that intellectual property rights are a stumbling block—an inhibition—not a roadblock to cooperation. In many cases, the problems are more apparent than real. However, firms and, on occasion, universities may not bother to investigate beyond the appearance. One participant thought that cooperative research, like any new activity, is often the victim of inertia. Intellectual property rights problems inhibit cooperative research not because they are so serious or difficult to resolve, but because they abet such inertia, causing delay and nuisance both within and between the organizations involved.

B. Industry-university negotiations difficult

Many explanations were offered for difficulties in industry-university negotiations. The differing structures of a university and a firm might be to blame. A research administrator noted that both university and business hierarchies resemble pyramids, but that the academic pyramid stands on its apex, not its base. He said that business negotiators were often surprised—or appalled—to learn how often university policies are established by the faculty and cannot be modified by the research administrator or even the university president.

The perspectives of business and academia differ as well. As an industrial representative noted, firms are accustomed to purchasing goods and services through binding contracts. Universities, on the other hand, get the bulk of their external research funding from appropriations, donations, or Federal grants, which attach relatively few conditions. A firm's contract administrator seeks to protect its interests through standard contractual "boilerplate". Academic administrators and researchers naturally resist what they perceive as unusual restrictions on university research activities. Each side resents the other's departure from standard operating procedure. (One of the Federal employees suggested that the same clash of perspectives can occur when a Government agency supports research as a "procurement" rather than "assistance" activity.)

The clash of perspectives seems to be only one symptom of a more serious problem—a failure to adequately understand the other party's interests. From the comments made by university participants, this misunderstanding lies mostly, though not exclusively, on the industry side. As an academic with much experience in cooperative research noted, firms sometimes forget that a university is not just a research performer. Universities have three institutional responsibilities: advancement of knowledge, education, and public service. The last of these is particularly important for state-run universities, which get most of their funds through a political process.

C. Intraorganization obstacles

Some of the participants indicated that industry-university differences and misunderstandings are frequently less troublesome to cooperative research than intraorganizational ones. Several persons commented that academic and industrial scientists seldom have trouble in identifying and designing worthwhile research

projects. The difficult cooperative research negotiations are those between staff (research administrators and lawyers), not line (researchers). Some believe this phenomenon is partly explained by the fact that an organization's staff may have a better, broader, view of organizational responsibilities, priorities, and goals. Legitimate concerns of the university or firm may not be apparent to the researchers. A few participants, however, felt strongly that cooperative research negotiations also often run afoul of the specialized concerns and narrow interests of university or industry staff who handle negotiations—that the tail wags the dog. If true, this might explain the disproportionate difficulties intellectual property rights, particularly patents, create in negotiating cooperative research arrangements.

Everyone at the workshop agreed that patents are *the* intellectual property rights issue. Copyrights were hardly mentioned and trade secrets reportedly seldom cause serious disagreement between universities and firms. One participant noted that in his experience, once agreement on patent rights is reached, other intellectual property rights questions are quickly resolved. A major reason for this is probably that patents are perceived to be more valuable than other forms of intellectual property. Another reason might be that patents are "countable" If a trade secret is disclosed, the economic advantage that might have been provided by exclusivity is forever unknown. The value of an invention that is disclosed but not patented is also forever unknown. If a patent is obtained, however, the economic value of the underlying invention may be identified and traced. "Countability" begets accountability. Someone can be held accountable for not having obtained rights to an invention at the time of negotiation, at the time the invention is made, or at any time during the seventeen-year life of the patent. Nobody wants to be labeled "the one who gave away the goldmine patent". The only way to insure against later regrets at not having obtained patent rights is to obtain patent rights. The natural human fear of failure, or of being seen to fail, presses the negotiator into an uncompromising position. Unfortunately, this pressure affects both industrial and academic negotiators. Conflict and even stalemate can result.

Some at the workshop, chiefly nonlawyers, were convinced that intellectual property rights negotiations are particularly difficult because they are usually handled, directly or indirectly, by lawyers. Lawyers are heavily involved with intellectual property rights because intellectual property, more than real or personal property, depends on satisfaction of legal conditions. Information does not become a trade secret unless it has certain attributes and, more importantly, is treated by its owner in a certain way. A writing is not fully protected by copyright (even under the 1976 Copyright Act) unless certain formalities are observed. A patent cannot be issued unless the invention and patent application satisfy the statutory criteria. For this reason, intellectual property rights matters are the particular concern of lawyers. Lawyers, by training and (some argue) by nature, are cautious individuals, forever guarding against the lawsuit that never occurs. Adding lawyerly caution to human fear of failure increases the "viscosity" or "friction" caused by patent negotiations in industry-university dealings.

D. Consensus

The consensus of the participants was that though cooperative research negotiations, particularly on intellectual property, are often difficult because of intersectional misunderstandings and intraorganizational interests, compromise and understanding can resolve the difficulties.

CHAPTER IV

TRADE SECRETS AND PROPRIETARY INFORMATION

Trade secrets and proprietary information, while potentially a source of great conflict between academia and industry, appear to be nonissues in most cooperative research arrangements. The participants reported that problems result most often from lack of thought or preconceptions, not from any basic conflict between academic and business ethics. There was general agreement on appropriate protection of a firm's pre-existing trade secrets and prompt publication of research results.

A. Pre-existing secrets

Everyone agreed that a firm must protect its pre-existing secrets and that secrecy would conflict with the education and advancement of knowledge functions of the university. This general conflict, however, apparently causes few specific problems. Only one instance was mentioned in which secrecy questions prevented cooperative research. That involved a refusal by a firm's lawyer to modify or omit some standard secrecy "boilerplate"—a clash more of perspectives than of essential interests.

There may be few problems in this area chiefly because firms have elected to keep their trade secret-related research entirely "in-house". One industrial participant opined that a firm would be foolish to entrust a valuable trade secret to outside researchers, whether academic or industrial. A decision that trade secret-related research is inappropriate for cooperative research might result from a firm's judgment that universities cannot or will not keep secrets. An academic research administrator noted that universities undeniably can keep secrets (the Los Alamos atomic research facility, after all, is run by a university), but that many have policies which rule out "secret research".

What is difficult or forbidden at the institutional level, however, can apparently often be accomplished by individuals. When university researchers do research in industrial laboratories, one academic said, they do often sign confidentiality agreements.

A businessman noted that, in fact, technical trade secrets are seldom an issue. Proprietary information—such as the fact that a firm was exploring a certain technology or planning to enter a particular market—is more often involved. No one saw a conflict between academic responsibilities and nondisclosure of that kind of information.

B. Secrecy of results

There was also general agreement that the results of cooperative research should be made public. The industrial participants recognized the university researchers' need to publish, both to exchange information and to establish academic credentials. An academic participant said many firms feel that the inevitable delay between submission and publication gives these firms sufficient advantage over their competitors. Everyone agreed that delaying publication for a limited time to permit filing of patent applications is reasonable. Periods of delay ranging from thirty days to one year were mentioned. One firm's patent attorney even suggested that a time limit would help avoid tardiness in filing.

C. Consensus

The consensus of the participants was that a firm's pre-existing secrets should and could be protected and that, except as necessary to protect patent rights, publication of cooperative research results should not be restricted.

CHAPTER V

PATENT RIGHTS

A. Basic patent rights

Representatives of some companies and universities say that they insist on "title" to or "ownership" of patents. This can be misleading because "ownership" of a patent, though typically evinced by holding legal title to it, actually consists of a package of different legal rights. Few—if any—negotiators need or really insist on having all of these.

The basic rights secured by a patent are:

1. The right to exclude others from practicing (making, using, or selling) the invention (This is the basic legal right secured by a patent, and is enforced by prosecuting infringers),
2. The right to practice the invention (without being prosecuted for infringement),
3. The right to license others to practice the invention,
4. The right to license the right to exclude others, and
5. The right to receive royalties from those licensees.

The legal "owner" or "titleholder" may alienate any or even all of these rights by a patent license. Correspondingly, a person may acquire, through license, any or even all of these rights without having title to the patent. If the "owner" licenses all patent rights, retaining only bare legal title, the licensee becomes owner for all practical purposes.

B. Strategies and interests

Some of the industrial representatives at the workshop said that their firms wish to be able to take advantage of the so-called "patent monopoly" and exclude their competitors from practicing an invention. Most companies follow this "exclusive" strategy". Other business participants, however, said that their companies only want to assure their own access to relevant technology and do not care whether others may practice an invention. They thus follow a "nonexclusive strategy". One person noted that his firm follows *both* strategies depending on its contribution to the research and the importance of the particular technology to its markets.

To pursue an exclusive strategy, a firm should "own" (i.e., control) at least the first four, and ideally all five, basic patent rights. To pursue a nonexclusive strategy, on the other hand, a firm need only obtain or retain one—the right to practice the invention.

Universities have three primary interests in patents. Primarily, they (and particularly their patent administrators) want to share in the income generated by university inventions. Second, they wish to protect themselves against charges that they have conspired to suppress or impede a new technology by ensuring that such inventions are commercialized. Finally, they wish to minimize the legal complications of commingling research support. To satisfy these interests, universities would prefer to "own" all five basic patent rights.

C. Problems between universities and exclusive-strategy firms

The conflict between exclusive-strategy firms and universities is obvious, since both ideally would like to have complete control of the patent rights, although for different reasons. Three issues seem to dominate negotiations in these cases: ownership of title, control of exclusivity, and, last but not least, royalties.

Ownership of title—in itself mostly a matter of form, not substance—is often the threshold issue. The critical point, of course, is not "bare legal title" but who controls the important patent rights. (Astute negotiators, recognizing that, may be able to trade "bare legal title" for substantive concessions.) Universities do have a valid reason for wanting title as such—the commingling problem. Separating research funding

sources is a difficult or perhaps impossible task in the informal academic environment. Under Federal grants, which support most academic research, the university can retain "title" to Government-supported inventions without difficulty, but cannot assign it without permission and holds it subject to certain Federal rights. If a university obligates itself to assign an invention to a firm and then discovers that, through commingling, the invention also received support from the Government or another firm, it may find itself in the position of having sold something twice. The universities may also want legal title for political reasons, since faculty members or state legislators unsophisticated in patent matters might equate not taking title with surrendering all patent rights. Why some companies insist on "title" is unclear.

The second issue is who will control the patent exclusivity and so determine who may practice the invention. The firm wants to be able to practice the invention itself, or not, and to license others, or not, as it determines is best for its business. If the firm sees that profits are maximized by keeping the price of the patented product high, it will do so. If it determines that its investment in an alternate technology would be destroyed, it may choose not to practice or permit others to practice a patented process. (Several investigations, however, have shown this last to be more a theoretical possibility than an actual practice.)

These practices are consistent with the university's desire to maximize its patent income (provided, of course, that the firm shares its profits or savings), but not with its public service responsibilities. The university, whether a public or private organization, is seen by its faculty, its students, and the general public as having a responsibility to promote the public interest. After all, state institutions and nonprofit organizations exist (in theory) because society has found that, due to market imperfections, some "public goods" or "good works" would not be supplied or performed by the private sector. Consequently, the university wants to ensure that its employees' inventions are commercialized so that the benefits are available to the public on reasonable terms. Universities do often grant exclusive licenses, but the workshop participants involved with academic patent licensing noted that they prefer to grant a license for a term of five or eight years (rather than the full seventeen-year life of the patent), to give exclusive rights only for certain fields of use, and to impose "working" requirements to protect the public against nonuse of the invention.

The final issue is money—slicing the patent income pie. From the workshop discussions, difficulties seem to arise from an inequality of bargaining power between the university and the firm. Academic patent administrators feel that firms too often fail to give universities a fair share of patent-related income. They say that firms exploit the academic researcher's much greater interest in current research support than in future university income from possible patents to obtain licenses for low, or often no, royalties. They say that while this occasionally results in "windfalls" for the companies, it tends to poison the industry-university relationship. On the other side, firms insist that they have the right, indeed the duty, to strike the best bargain they can. Business representatives point out that eliminating royalties entirely is desirable because that forecloses disputes between the university and firm as to whether a certain invention is incorporated in or used to manufacture a particular product. They also maintain that the exchange of future patents for current funding may be a good deal for the university as a whole, if not for its patent administrators.

D. Problems between universities and nonexclusive-strategy firms

The conflict between universities and nonexclusive-strategy firms may seem less obvious, but may actually be more troublesome, particularly since these firms currently fund much, perhaps most, of industry-university cooperative research.

The "title" question does not arise, of course, since nonexclusive firms are willing to let the university keep most patent rights so long as they receive a right to practice.

However, the "exclusivity" question is stood upon its head, to the university negotiator's disadvantage. Now the firm insists on nonexclusivity, at least to the extent that it always be allowed to practice the invention. A firm that follows a nonexclusive strategy usually has one or more of the following characteristics:

1. It is involved with a fast-moving technology. Patents are of little value because an invention will likely be obsolete before one issues and because competitors can "invent around" the patent.
2. Its products are complex, containing many patentable components. As a result, the potential costs of negotiating individual patent licenses is high and the industry naturally gravitates towards cross-licensing.
3. Finally, the firm is a large, market-dominating company which is more likely likely to be hurt than helped by restrictions on the spread of technology.

General Electric, AT&T, International Business Machines, and Exxon, four nonexclusive strategy firms mentioned at the workshop, each obviously has at least one of these characteristics. A nonexclusive right to practice held by one of these firms is believed to discourage commercialization by anyone else. Another firm may be reluctant to bear the costs of introducing a new product if it knows that the dominant firm has the right to come into the resulting market, which it is likely to dominate as well. If the large firm's license

thus discourages others from practicing the invention, the university obviously cannot earn royalty income from anyone except its former cooperative research partner. This means that the university patent administrator gets a patent that cannot be successfully licensed.

Instead of limiting exclusivity to protect the public against nonuse or excessive "monopoly" profits, the university in this case tries to preserve exclusivity to salvage its licensing opportunities. Those unfamiliar with the innovation process, however, often do not understand the notion that a patented product may be produced only if the number of persons able to produce it is limited so that the prospects of extra profits will justify undertaking the often extraordinary investment and risk-taking associated with initial commercialization. As a result, the university finds itself in an uncomfortable position, arguing against free access to technology and for more profits. From the firm's view, of course, to expect it to fund research without assuring that it can use the fruits of that research is unreasonable. After all, a nonexclusive license to possible inventions seems a very small return for thousands of dollars of research support.

Universities might find this situation easier to accept if the firm's nonexclusive license bore substantial royalties. However, the inequality of bargaining power between the university and the firm is perceived as particularly great with nonexclusive firms and the university often gets no royalties from its nonexclusive license. Since one characteristic of a nonexclusive firm is the complexity of its product, such firms may have a particular incentive to foreclose patent disputes by obtaining royalty-free licenses. This is obviously a very sore point with universities, certainly with their patent administrators. So it is that negotiations between universities and nonexclusive-strategy firms are often difficult and bitter.

E. Miscellaneous rights

In cooperative research negotiations with both exclusive and nonexclusive firms, numerous subsidiary patent issues arise. These include:

1. Who controls publication of results to protect patentability,
2. Who decides whether or not to file a patent application,
3. Who drafts the patent application, particularly the claims,
4. Who pays for patenting and maintenance costs, and
5. Who decides when to sue for infringement.

Except for the first, these issues are of interest primarily to patent attorneys, but they can be another source of delay and difficulty in putting together industry-university deals. From the comments of the workshop participants, a "clash of perspectives" may complicate negotiations over these subsidiary issues. Representatives from industry thought these matters should be specified in the cooperative research agreement, while those from universities indicated that these items could be left until after an invention is made.

F. Consensus

The consensus of the workshop was that there are genuine conflicts between universities' interests in patents and firms', particularly in respect to exclusivity and royalties. These conflicts, however, can be, and typically have been, resolved through good faith negotiations.

SOLUTIONS AND FURTHER ACTIONS

The workshop participants agreed that many of the intellectual property rights difficulties in industry-university cooperative research projects are caused by inexperience and misunderstanding. More information is needed, especially by new entrants. Several private groups were reportedly considering the creation of an cooperative research information clearing house to help alleviate this problem.

The participants saw little role for the Government in resolving these difficulties. Several believed that the Bayh-Dole Act (35 U.S.C. §200 *et seq.*), enacted in late 1980, would encourage cooperative research by lessening the commingling problem and by publicizing the fact that universities can give companies patent rights. (Experience since the workshop has apparently confirmed this belief.) The participants felt that successful industry-university collaborations would beget more interest in cooperative research and that a "snowball" effect would occur without any major attempt to promote cooperative research.

APPENDIX A: Participants in NSF Workshop on Intellectual Property Rights in Industry-University Cooperative Research

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