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Longer Leadtimes: A Symptom of Soviet Problems in Using Western Technology

A Research Paper

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Longer Leadtimes: A Symptom of Soviet Problems in Using Western Technology

A Research Paper

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Longer Leadtimes: A Symptom of Soviet Problems in Using Western Technology

Key Judgments

Information available as of 15 April 1984 was used in this report.

Soviet use of imported Western plant and equipment has fallen far short of its potential for improving the USSR's overall economic performance, in large part because the Soviets take so long to acquire and put to use many of these imports. Average leadtimes are much longer in the USSR than in the West, almost invariably exceed the plan, and show no signs of diminishing.

The picture is not uniform. Imports for projects in high-priority sectors—defense and energy, for example—usually get special handling and, as a result, are acquired and assimilated promptly. In most other sectors, however, a variety of factors—some unique to imported technology and some affecting domestic as well—prolong the leadtimes:

- *Divided responsibility.* The lack of a single body to coordinate all stages of the import acquisition and absorption process fosters redundancy, prolongs negotiations, and slows down the assimilation of new technology.

- *Administrative barriers.* Official reluctance to permit personal contacts with foreign suppliers isolates production managers from important Western sources of information about the equipment, often leading to improper installation and prolonging the period of adjustment.

- *Accounting practices.* Because the Soviet economic system levies a very small interest charge on capital assets (both domestic and imported), no one feels obliged to get imported equipment into production quickly.

- *Incentives.* By emphasizing quantitative output, the Soviet incentive system breeds resistance to technological change

Individual Soviet end users probably can save time by importing a product embodying new technology rather than waiting for its development in the USSR. However, diffusion—the widespread use of a new technology throughout the economy—may be faster with indigenous development. This is primarily because the Soviets seldom begin the research and development needed for embodying imported technology in Soviet-produced equipment until the import has been operated in a "prototype factory." From initial expression of interest to factory operation generally takes two to seven years

Nevertheless, as the pinch on labor, capital, and natural resources tightens and the leading edge of Western technology continues to advance, the Soviets will continue to import Western technology and equipment to alleviate bottlenecks and modernize domestic industries. Even though effective diffusion of technology might occur more quickly through indigenous development, Moscow will continue to rely on import because the USSR puts a greater premium on satisfying current requirements for equipment and technology than on potential long-term uses.

The USSR is trying to speed up the assimilation of new technology in nonpriority civilian projects through various reorganizations and special bonuses. Results continue to be disappointing, however, to judge by the chronic official complaints. We believe the prospect for improvements will remain dim, barring a major overhaul of the system of incentives for modernization

More important, as long as the USSR relies on imported plant and equipment for its most advanced civilian technology, it will continue to lag in the generation of new technology. Even though Soviet engineers who study imported equipment may note well what the Western designers have done, they may still—not having gone through the designing experience—be ill prepared to carry the embodied technology further

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Introduction

Despite its high degree of self-sufficiency, the Soviet Union has traditionally imported Western technology to help ease bottlenecks, raise efficiency, and modernize its economy. Imports of Western plant and equipment expanded rapidly in the 1970s, as Moscow increased its emphasis on these goals in response to increasingly severe material and expected manpower shortages

Such imports have significantly benefited specific sectors. They contributed much, for example, to the substantial enlargement of the natural gas pipeline network and the major advances of defense industries. But the Soviets hoped that Western technology also would stimulate productivity—not only in the individual plants where the imports were used but also generally, through diffusion. This has not happened.

There is, in fact, direct evidence that Soviet handling of legally acquired Western technology for use in the civilian economy has been notably inefficient. A prime example is the disproportionate length of time the Soviets take in assimilating and diffusing most imports of Western plant and equipment.[1] These excessive leadtimes play a major role in diluting the potential benefits of such imports

Our focus in this paper is on the overall pattern of handling foreign technology. Drawing on comparisons with Western experience, we identify factors that prolong the process of acquiring and using imports in the Soviet economy. We describe the performance of the Soviet system in each stage of the assimilation and diffusion of imports and compare that to the system's performance with domestically generated technology.

Obviously there are exceptions, most notably priority projects in the defense and energy sectors. Their shorter leadtimes usually reflect official actions to override the obstacles built into the system. These actions include (1) allowing the end user more direct participation in import negotiations, (2) promptly authorizing payment in hard currency, and (3) intervening to guarantee on-schedule delivery.

Acquisition, Assimilation, and Diffusion of Imports

The process of legal acquisition and use of Western plant and equipment for the civilian economy can be divided into six stages:

- Discovery of Western plant or equipment (initiation of interest).
- Request for funds.
- Negotiation of Soviet foreign trade organization (FTO) with Western suppliers.
- Delivery, installation, and first use.
- Assimilation of the import by the original end user.
- Diffusion of the embodied technology to relevant uses throughout the economy

To work well, the process must facilitate the flow of information, reward initiative and innovation, foster trade, and provide the know-how and resources for production with the new equipment or process. In no country, of course, does it work perfectly. But in the USSR the process is seriously flawed in almost all stages by:

- An inefficient decisionmaking apparatus.
- Lack of motivation to innovate.
- A xenophobic leadership.
- The treatment of capital assets as virtually free goods.
- Protracted construction times

[1] Assimilation is the mastering of new technology by a single end user. Diffusion is the use of it throughout the economy. In this paper the phrase "assimilation and diffusion" refers to all of the stages from initial Soviet interest in a technology to its economy-wide adoption

In the Soviet Union, responsibilities for decisions that affect innovation and import policy in the civilian economy are shared by a number of organizations, including the State Planning Committee (Gosplan), the State Committee for Science and Technology (GKNT), the Ministry of Foreign Trade, the Ministry of Finance, and the various industrial ministries. Within these organizations, the import decisions are made primarily by a few officials in the central administrations. These officials are usually geographically separate from the end users they are supposed to represent and are not always well informed about all the technologies in which they have trading interests—despite the Soviets' well-organized system for collecting and disseminating information

The officials responsible for innovation are further handicapped by a frequent lack of common objectives with the end user. An enterprise manager often resists innovation because it causes downtime and other short-term disruptions of plant operations, and these jeopardize his fulfillment of immediate sales and production goals—his prime success indicators. Such resistance, in turn, tends to discourage the import decision maker, who also fears being identified with a failed innovation attempt. This conflict of objectives encourages temporizing and buckpassing and makes the import process even slower

The Soviet Union's high degree of self-sufficiency further weakens the motivation to trade. Trade has never been crucial to its economic survival, and today—despite the expansion of trade in recent years—imports account for only 5 to 10 percent of Soviet GNP. Xenophobia, deeply rooted in Russian history, has inhibited the Soviet ability to make the most of Western technology, even when imports are expanding rapidly. For example, when detente flourished and imports surged in the early and mid-1970s, the Soviets still severely limited Western participation in economic projects—participation that would increase foreign contacts and possibly diminish Soviet operational control. Even though management studies showed long ago that technology is more efficiently transferred through personal interaction than through technical documentation alone, the USSR has placed significant limitations on foreign travel for its people and on visits by Western technical advisers. The Soviets rely, for the most part, on Western publications to identify and learn how to use Western imports.

The Soviet economy treats capital as virtually a free good. This attitude contributes to long leadtimes by reducing the motivation to put new plant and equipment into operation as promptly as possible. This particular problem is not peculiar to imported technology but reflects a general managerial indifference toward having capital tied up, whether that capital is imported or domestic and whether it embodies new or old technology

This indifference prolongs construction times, and building delays in turn delay the assimilation of Western technology. During the 1970s Soviet sources estimated that the building of an enterprise from the initial design to full-capacity operation took five to seven years on average; it takes only two to three years in the West. A more recent Soviet estimate (1980) puts the average leadtime for all projects at eight to 10 years. Since new technology is generally made operational through new plant and equipment, the far longer construction times mean that all technology, both imported and domestic, is brought on stream much more slowly in the USSR than in the West.

In the Soviet chemical industry, for example, the time that elapses between Stages 2 and 5 (initial inquiries about import contracts and operation of the purchased plant and equipment) is roughly two to three times as long as in the West (table). In the machine tool industry, the time between contract inquiry and first production is more than twice that required by Western firms.[1] In two of the six stages of the process (negotiation and installation/first use), Soviet firms take three times as long as Western firms

[1] This figure is based on a survey by Dr. M. R. Hill of eight British manufacturers that provide machine tools to both Western and Soviet purchasers; reported in *Soviet Absorption of Western Technology: A Survey of West European Experience*, by Malcolm Hill and Philip Hanson, Stanford Research Institute, December 1978.

Leadtimes in the Chemical Industry, Soviet and Western

	Years	
	In the USSR	In the West
Imported plant and equipment [a]		
From contract inquiry through negotiations	1.5	0.8
From the end of negotiations to initiation of production [b]	5.2	2.3 to 3.0
Total	6.7	3.1 to 3.8
Soviet indigenous development [c]		
Research, development, testing, evaluation, and achievement of normal-capacity operation	15.0	

[a] *Soviet Absorption of Western Technology: A Survey of West European Experience*, by Malcolm Hill and Philip Hanson, Stanford Research Institute, December 1978 (a survey of 31 projects).
[b] Initiation of production is an earlier stage than the attainment of normal-capacity operation, the stage cited in our source for Soviet indigenous development in the chemical industry.
[c] V. S. Sominskii (survey of 132 projects); referred to in *Trade and Technology in Soviet-Western Relations*, by Philip Hanson, New York, Columbia University Press, 1981, p. 79.

The large difference in the time required to put new technology (domestic or foreign) into operation in the USSR and in the West is also indicated by the interval between the application for an inventor's certificate on new technology and first use of that technology. For instance, a 1979 Western study comparing the implementation of inventions in the USSR, the United States, and West Germany showed that 50 percent of those sampled had been implemented after little more than a year in the two Western countries and after over three years in the Soviet Union.[1] At the end of two years, 66 percent of the sampled US inventions had been implemented, 64 percent of the German, and only 23 percent of the Soviet

[1] "Soviet Implementation of Domestic Inventions: First Results," by John Martens and John Young, in *Soviet Economy in a Time of Change*; A Compendium of Papers Submitted to the Joint Economic Committee, Congress of the United States, 10 October 1979, pp. 472-510

For the Soviets, Western rates may be less important than whether they themselves can assimilate an imported technology more quickly than one developed at home. As the table shows, if the technology is not available domestically, importing saves time. However, if equipment embodying the technology is already available in the USSR, assimilation is presumably speedier through its use, rather than through imports. But even in this case, Soviet enterprises sometimes prefer Western suppliers because they are supposed to be more reliable. In fact, however, this reliability can be offset by delivery delays after shipments have reached Soviet soil. Furthermore, US-Government-imposed sanctions have on occasion caused US suppliers to suspend contractual obligations to Soviet buyers

Moreover, even if importing speeds up assimilation by one end user, it is not clear that it accelerates diffusion throughout the economy. Diffusion usually requires that a new technology be embodied in Soviet-produced equipment—a time-consuming process that often demands considerable research and development. The USSR seldom begins such R&D work until assimilation of imported plant and equipment is well under way or even complete. This is usually some two to seven years from the initiation of interest by the Soviet end user (Stage 1).

Additionally, there is evidence that the Soviets sometimes—perhaps frequently—fail in their attempts to accomplish diffusion (Stage 6).[a] According to [redacted] successful diffusion of an import within the civilian economy is rare. Consequently, he said, imported Western technology has not produced dramatic changes in the economy, and technological advances in Soviet industry continue to depend primarily on domestic research and development

At least three Western studies have shown that in the Soviet chemical industry a high level of imports,

[a] It is important to note that the Soviets import for a wide variety of purposes, including alleviating bottlenecks and supplementing domestic production, and thus do not try to diffuse all imports throughout the economy

continued over a long period of time, has tended to perpetuate dependence rather than end it. One, [redacted] shows that despite a need for specialized equipment (which the chemical industry has been importing for the past 20 years), the machine-building industry has made only limited progress in its production. This prolonged dependence ensures a continued lag of Soviet technology behind that of the West. Both Western and Soviet observers have noted that even if a new technology reaches Stage 6 in the Soviet Union, it often has taken so long that the diffused technology is obsolete.

Moreover, the Soviets evidently are not improving with experience. A statistical test—based on survey data from Western businessmen collected in Philip Hanson's chemical industry study of 31 projects—has indicated that leadtime performance has not improved over the last 20 years, despite Soviet industry's increasing familiarity with the same Western firms.[6]

The Soviets themselves seem dissatisfied with their leadtime performance. Articles drawing attention to uninstalled or malfunctioning imports often appear in the Soviet press. One such article concluded that the actual time from plant commissioning to attainment of full capacity can be up to 50 percent longer than the planned time. [redacted] a large share of all foreign equipment is almost useless because it is delivered so late that it no longer fits in with the enterprise's plans. These problems persist, even though the Soviets seem to assign higher priority to the assimilation of Western equipment than to that of domestic equipment (see inset).

Determinants of Leadtimes in Each Stage of the Import Process

Stage 1: Discovery of Western Plant or Equipment

The Soviets have developed a massive and effective system for collecting and disseminating information on Western technology. The key organization in this effort is the large Moscow-based All-Union Institute for Scientific and Technical Information (VINITI). It collects Western materials in scores of technology areas and distributes compilations (usually monthly) to R&D institutes and ministries throughout the country. The VINITI documents are supplemented by material from other Moscow-based clearinghouses, reports filed by Soviets who have traveled abroad, and subscriptions to Western journals.

The distribution system functions smoothly, but its usefulness is to a considerable degree offset by certain impediments. For example:

- A thorough grasp of the Western data often depends on instruction that can be provided only by direct personal contact with suppliers—which the Soviets often forbid or sharply limit.

- The scope of technologies in which the Soviets have trading interests is too great for the relatively limited number of import decision makers to adequately grasp through their own efforts. (These decisionmakers are primarily officials in Gosplan, GKNT, the Ministry of Foreign Trade, and Moscow- or Leningrad-based ministerial offices who are far removed from the day-to-day activities of production and R&D enterprises.) Therefore they must rely on these enterprises to accomplish the bulk of the review of Western literature and to submit pertinent information and recommendations to them. These enterprises, however, may distort the information they give to the decisionmakers—or even withhold information—in order to escape pressure to innovate.

Central authorities attempt to counterbalance this reluctance to innovate through a combination of administrative direction and tinkering with incentives. The former are generally annual "innovation targets" levied on a ministry and its constituent enterprises. The latter involves modifying economic or organizational mechanisms to provide incentives without changing the basic command structure of the system.

[redacted]

[6] *Trade and Technology in Soviet-Western Relations*, by Philip Hanson, NY, Columbia University Press, 1981, p. 196-199

The high priority assigned to assimilation of Western equipment is evidenced by a decree issued in September 1979. This established a basic bonus of 3 percent of the total value of construction and installation work for on-time project completion and provided a 25-percent increase to this bonus for projects using large amounts of imported equipment. In October 1983 a separate resolution was issued ordering ministries to ensure that imported equipment is put into service and brought up to capacity operation within the warranty period

Soviet officials have recently criticized the foreign trade organizations for foot-dragging in their negotiations with Western suppliers. This suggests continuing attention to the problem of import leadtimes

Even seemingly sensible centrally directed measures often go awry, however, in the prevailing sellers' market, where chronic shortages force buyers to take what they can get. For example, guaranteeing a higher price for a new product stemming from innovation often leads to "gold-plating"—pseudo-innovation in which a manufacturer represents as new or improved a product that has in fact had only a cosmetic change. The combination of centrally controlled allocation of resources and the weak bargaining position of buyers enables such activity to spread widely

Even though disincentives far outweigh incentives for innovation, not all innovation targets are met through deception. There are some reasons—although not many—for enterprise managers to pursue real innovation

Genuine innovation probably helps ministerial and enterprise officials gain attention from higher authorities and thus enhances their career prospects. In a few cases, managers may be forced to introduce real change in response to centrally exerted pressures. These pressures are applied at the enterprise level through an Enterprise Technical Council, which monitors the enterprise's technical achievements and reports to the ministry. The enterprise also has a fund for innovation, and management has an incentive to make it appear that this fund is being used well

Whether inspired by the carrot or the stick, however, innovation tends to be conservative, even when it is genuine. Since many production managers view Western companies (especially West European and Japanese) as more reliable than Soviet suppliers, they often choose importing as a way to meet innovation targets. Ministries, for the most part, try to inaugurate new technologies in new facilities, because innovations in an existing plant often require production adjustments that threaten its ability to satisfy its existing performance indicators. Furthermore, new facilities increase the size and prestige of the ministry.

Stage 2: Request for Funds

After enterprise or ministry officials have identified a potentially useful import, they begin the process of getting approval to enter into trade negotiations. This is usually complex and protracted, except for imports deemed by central authorities to have high priority. According to [redacted] the application to purchase machinery must demonstrate that the import is needed, that the USSR has no suitable substitute, and that money would be saved by the purchase. The application must include statements from relevant Soviet ministries that they cannot provide the equipment in the required quantity, quality, and time

The actual purchase justification is submitted first for ministry review and then (if tentatively approved) to the central authorities. A [redacted] reports that such a document may contain up to 50 typed pages

Developing a purchase justification is a time-consuming procedure, generally requiring the following steps:

- Consultations within an enterprise's design bureau or between it and other interested organizations to formulate a "first cut" technical specification.
- Submission of technical specifications to a ministry technical review committee with an explanation of the purpose of the import, for preliminary approval.
- Resubmission (after preliminary approval) with a detailed funding request and the documents showing that the technology is not available from domestic sources.

The ministry's technical review committee evaluates the justification request and either denies it or sends it forward for funding. If approved by central authorities, the funds are usually included in the ministry's annual plan. Since plans are formulated three to six months before they go into effect, a significant amount of time can be lost in the budgeting cycle. A former Soviet industry [redacted] has estimated that as long as 18 months may elapse between ministry approval and the beginning of negotiations with the foreign supplier. (Similar delays can be expected for projects involving domestic resources, since they must usually go through this same application process.)

Inertia seems to be a major determinant of budgeting for imports. [redacted] reports that industrial ministries routinely win renewal of yearly allotments for imports at a nearly constant level. However, the central authorities tend to place requests for increased or new funds at the bottom of their priority list, and if the funds are approved the lag before import negotiations begin is generally longer than for renewal requests. In many instances, addiction to routine, coupled with tightening hard currency constraints, apparently takes precedence over the need for new technology from abroad.

Stage 3: Negotiation With Western Suppliers

[redacted] has reported that a large Soviet foreign trade organization like Mashinoimport is responsible for conducting some 10,000 trade negotiations annually—many more than its staff can handle expeditiously. This problem is recognized by Soviet authorities. [redacted] recently told [redacted] that his FTO "cannot always give expedient attention to smaller equipment contracts." Once negotiations do begin, they typically take three times as long as in the West—for several reasons, including the need for approval from multiple sources. An import order may need as many as 18 signatures.

The bureaucratic and geographic separation of the FTO negotiating team from the Soviet end user also stretches out the process. The FTO is qualified to pursue commercial negotiations, but usually not the necessary technical discussions. Since end users are not often part of the formal negotiating team, special arrangements must be made for their participation. This requirement prolongs leadtimes by making the commercial and technical aspects of the negotiations relatively distinct and sequential, instead of overlapping. Still, cases exist where the end user does not participate in the negotiations at all (see inset)

Leadtimes are further lengthened in Stage 3 by the incentive system for FTO negotiating teams. This usually emphasizes economizing on foreign exchange, obtaining favorable financing, and extracting price concessions. Negotiations to achieve these objectives are often time consuming, even though the interests of both individual end users and the economy as a whole might be better served by speedier import of the technology being sought.

Leadtimes are also prolonged by the exclusion of foreign advisers from most projects. Western companies find it difficult to supply all relevant instructions and documentation because of the Soviet reluctance to supply information on how and where the import will interface with existing systems and plants. For example, the Soviets significantly limited Western suppliers' visits to the Kama River Truck Plant and withheld drawings of the buildings in which the imported equipment was to be installed.

To get as much as possible out of this one-way flow of information, the Soviets often demand vast amounts of documentation. [redacted] reports that a typical proposal prepared [redacted] to Soviet specifications filled a box of approximately 36 cubic feet. Furthermore, an FTO normally sends inquiries to a fairly large number of competing Western firms (in the case cited, seven) and must usually study all their proposals before it selects the firms with which it will negotiate further

Great detail is later required in the contract itself and in the operating instructions. For example, [redacted] cites operating instructions in which his initial wording was "Open valve A." This was amplified, at Soviet request, to read "Open valve A, using both hands, three turns counterclockwise." The final instruction package was four times the size normal in the West

Because of information transmittal problems resulting from bureaucratic and geographic separation, FTOs may order equipment that the end user cannot use. [redacted] report that expensive "automated furnace" equipment purchased for the iron foundry at the Kama River Truck Plant has never been installed, because it was not requested by foundry managers and is inappropriate to their needs. In another case, a [redacted] recalls that the Ministry of Foreign Trade failed to include representatives of his enterprise in the negotiating team sent to purchase computer equipment—even though the Ministry was not familiar with his enterprise's special requirements. As a result, the computerized banking system that the Ministry purchased from France proved to be "a colossal failure, because it was designed for a capitalist system and could not be adapted to Soviet needs."

Two other Soviet tendencies can cause delay at the negotiation stage. One is to word an initial inquiry so vaguely that many Western firms do not realize they have been asked to make a proposal, and the other is to interrupt negotiations for substantial periods without warning or explanation.

Stage 4: Delivery, Installation, and First Use

Leadtimes in Stage 4 are long; the overall leadtime from initial contact to first use of the import is often three to four times the normal leadtimes in the West, according to Western studies of the chemical and machine tool industries.[1] Soviet literature is replete with examples of poorly formulated shipping schedules, inadequate port facilities, and shortages of domestic transport—all of which tend to stretch out delivery of imports to the end user.

Another cause of delay is the fragmentation of authority. Domestic shipping channels are so arranged that imports must be cleared through a number of checkpoints, each under a different jurisdiction, before final delivery. This multiplies the opportunities for bureaucratic delay.

Once the import arrives, the Soviet end user faces a whole new set of obstacles. If the plant is new, the lag associated with installation is particularly lengthy—primarily because of problems in the construction industry. According to [redacted] the purchasing officers who select imports for new plants and arrange for their delivery must do so during the planning stages of the project—years before the plant will be ready for installation of equipment. However, 50 percent of all construction projects are completed behind schedule (even though the schedule is anything but demanding).[2] As a result, the Western producer often delivers equipment long before the construction of the plant is at the stage where it can be installed.

A recent example [redacted] The Soviets insisted that production units for a Caspian Sea project be delivered in 1984, even though drilling was not scheduled to be completed before late 1985. The equipment will thus "sit idle for at least a year and develop rust, lubrication, and/or dry rot problems."

A plant presumably can adjust a domestic delivery schedule more easily than it can revise an international contract. Thus, the lack of coordination between equipment deliveries and plant preparation probably is greater when the equipment is imported.

Even if the plant is built and already producing, the lag in installing imported equipment can still be significant; it often has been the subject of criticism in the Soviet press. The chemical industry's handling of imports was derided in a *Pravda* cartoon of August 1981 showing a plant buried under crates of machine tools. The accompanying narrative stated that the

[1] *Soviet Absorption of Western Technology: A Survey of West European Experience*, by Malcolm Hill and Philip Hanson, Stanford Research Institute, December 1978, and *Soviet Absorption of Western Technology*, by Heinrich Vogel and Karl Rothlingshofer, Stanford Research Institute, March 1979.

[2] Major reasons for this are the low cost of construction investment funds and an incentive structure that rewards a new construction start more highly than a job completion.

[redacted]

Novopolotsk Production Association "Polimer" had not made any use of imported equipment valued at 674,000 rubles and that in 1969 the Usolskiy "Khimprom" Association had received imported equipment worth 650,000 rubles that had never been installed and had, in fact, deteriorated beyond repair while in storage. In 1979 Soviet authorities checked 45 petrochemical complexes and found 24 at which equipment awaiting installation was lying unprotected. Such negligence results from a host of problems—many of which affect the handling of domestic as well as imported equipment.*

* These general problems include lack of tools, unpredictable fluctuations in the labor force, slow decisionmaking, a general lack of entrepreneurship, and poor worker motivation.

Still another important factor can prolong leadtimes in Stage 4: a reported Soviet procedure of sometimes requiring that 80 percent of total equipment be delivered before installation begins. Because deliveries for new plants (or for major renovation projects in old plants) are often spread out over many months or years, equipment that could have been installed may instead lie deteriorating pending arrival of additional shipments.

Stage 5: Assimilation

Soviet sources indicate that the intervals between first use of imported equipment and its use at rated capacities are frequently 50 percent longer than Soviet planners consider normal. There are two main reasons for this:

- Difficulty in finding reliable suppliers for the materials and equipment necessary to install and service the new technology. This reflects, in part, the characteristic tautness in Soviet plans.
- Faulty coordination among central planners with responsibility for different phases of the same project.

A current example of poor planning has a supplier plant and an end-use plant being built at the same time (each by a Western contractor), over 900 kilometers (km) apart. This distance greatly increases the probability of delivery problems. US engineers have noted that if the two plants were constructed in the West, they would be no more than 15 km apart

Because supply uncertainty is more the rule than the exception in the USSR, Soviet enterprises tend to produce in house the items they really need. This inefficient practice can cause downtime and equipment malfunctions that, among other negative consequences, can delay the achievement of rated capacity.

When new technology—foreign or domestic—is used in a new enterprise, managers may attempt to minimize the risk of failure by altering the criteria used to monitor their performance. They can do this, for example, by deliberately operating at less than optimum rates, out of fear that higher rates may convince superiors to set more demanding norms

The difficulty the Soviets have experienced in meshing imported and domestic machinery is another major cause of delay in Stage 5. In some imported ammonia plants, for example, incompatibility of domestic and foreign machinery has caused equipment malfunctions resulting in significant production delays. Other industries have been affected as well. The failure of domestic and foreign equipment to dovetail has been a major problem since 1980 at the Nairit Production Association. This incompatibility delayed the opening and impeded the subsequent smooth functioning of a synthetic rubber production line there. Furthermore, in 1982 it caused a pollution accident that prompted local sanitation authorities to order production stopped until the necessary repairs were made; this task was scheduled to be completed by the end of the current five-year plan.

Malfunctions in imported plant and equipment often stem from the processing of low-quality or otherwise unsuitable materials and from inadequate preventive maintenance. Examples include the breakdown of imported machinery when it was used to make parts from steel with too great a tensile strength or parts that exceeded permissible dimensions and weights. A Western bearing cage production line at a Soviet plantswent out of commission because of the use of inferior Soviet bronze

Another important constraint on putting imports into service promptly is the Soviet reliance on technical documentation for learning how to use equipment. A good example is the experience the Soviets have had in trying to use the IBM Information Management System. This was imported in 1974 but, [redacted] has never worked well—mainly because the Soviets have used only the written instructions. These are incomplete because IBM expects to send its own people to help end users—an offer rejected by the Soviets

Whatever the cause of equipment malfunctions (lack of information, poor maintenance, improper raw materials, or labor problems), their effect depends on how quickly the Soviets can get the equipment working again. Here their record is poor. Even when they do allow Western technicians to service imported equipment, bureaucratic meddling often delays the work. [redacted] has reported that in order to make one hour of repairs at an acetic acid plant in Severodonetsk, he spent two weeks in the USSR.

Also, [redacted] indicate that it is usual practice to buy few or no replacement parts to avoid spending foreign exchange. Therefore, a breakdown of the simplest part can cause an extended delay as replacements are ordered from the West or fabricated locally. This problem—a major source of delays—occurs more frequently as equipment ages. Recently one-half of the 50 Western-made bulldozers used by the Lenzoloto Production Association gold-mining facility lay idle because of a lack of spare parts

According to a [redacted] the parts shortage has kept many of the imported US pipelaying machines—critical to the USSR's petroleum industry—out of service for extended periods. The problem also plagues oil drilling activities. [redacted] indicate that it is getting worse and that spare parts portions of recent import contracts for the petroleum drilling industry have in many cases been cut by over 50 percent.

Stage 6: Diffusion

Successful diffusion usually requires becoming independent of imports by producing the equivalent plant and equipment domestically. This arduous technical task is becoming increasingly difficult because of the growing complexity of the imports. In many cases the Soviets lack the skills and materials needed for series production of similar items. Additionally, Soviet researchers do not always have access to the types of equipment and resources used in the West and thus have difficulty achieving the necessary quality standards

For example [redacted] reports that in the late 1970s the research staff at the Mechanical Project Institute for Oil and Water Equipment in Moscow spent several years trying to develop a submersible pump for use in oil wells. The staff took apart a number of US pumps and attempted to copy them with minor modifications. The major stumbling block was the refusal of Soviet industrial officials to

supply the materials on which the quality and durability of imported pumps depended. Staff engineers were amazed that US companies could easily obtain nickel and other metals for their pumps, since Soviet strategic metals are reserved primarily for direct defense applications.

Soviet failures in diffusing imported technology result not only from organizational mismanagement and inferior technological capability, but also from the practice of keeping existing facilities and equipment in use far longer than in the West. Demand is so great that old and inefficient plants can still sell their output and continue to operate. Thus, there is a significant variation in physical configuration, equipment, and performance standards between plants producing the same goods. These variations doom to failure most attempts to force-fit to one plant the complex imported equipment that works in another.

Even when the Soviets have successfully diffused imports, their leadtimes, compared to those in the West, have been extremely long. Long lags in Stage 6 are not unique to imports, however: many of the same influences also impede the diffusion of domestic technology.

The successful adaptation of imports for use as Soviet-made products must begin with R&D concepts that are workable, but the geographic and bureaucratic separation of most R&D organizations from end user plants deprives the R&D employees of full knowledge of the environments within which their concepts must work. The R&D incentive system in the USSR, which usually allows bonus payment before an idea is translated into production, does not encourage the R&D employee to seek such knowledge. This partially explains the significant gap between research and application in the USSR.

The Soviets have attempted to close this gap and speed up the innovation process through the use of scientific-production associations (NPOs) that bring research, development, and production responsibilities together under one roof. They claim that the NPOs, which currently number more than 250, have reduced leadtimes by 50 to 65 percent. They probably are referring, however, to the time between the R&D phase and first use in the NPO plant, not between R&D and economy-wide use. Additionally, NPOs are often assigned normal production quotas by their industrial ministry bosses, in addition to their experimental work toward speeding up innovation. Sometimes they have even been ordered to cease experimental work altogether in order to make up for losses of production elsewhere in the ministry.

The efficiency of Soviet R&D institutions in formulating workable concepts is also impaired by the low quality (and sometimes virtual absence) of support services and equipment. A Soviet survey of 300 design institutes in different branches of industry showed that 85 percent of them copied designs and technical drawings by hand. [ ] estimated that the Soviet Union has only 20,000 to 30,000 photocopiers—a small fraction of the number that a Western country of equivalent size and development would have. This is a symptom of a more general Stage 6 problem, which [ ] has described as "insufficient laboratory equipment and very poor manufacturing capability to produce new types of industrial-scale equipment."

Misallocation of R&D labor resources also lengthens leadtimes. This problem has two parts. First, most well-qualified scientists, for prestige and other reasons, pursue theoretical work in research institutes—which are not the prime movers in applied R&D and diffusion. Second, the successful performance of pilot plants developed to manufacture prototypes requires highly skilled blue-collar workers. However, [ ] reports that the demanding work in a pilot plant receives about the same pay as the less taxing work in a production plant and that the pilot plant workers have smaller "bonus pools" than those in production. As a result, the innovating sector cannot attract the talented workers it needs—significantly weakening R&D performance and prolonging leadtimes.

After workable R&D concepts are formulated and pilot tested, there is still no assurance they will ever be introduced into serial production. The R&D establishment, for the most part, lacks the authority (even when it has the desire) to force implementation of its recommendations over the objections of plant managers.

Examples of Gains From the Use of Western Equipment

- *The Soviets could never have accomplished their ambitious 15-year program of modernization and expansion in the motor vehicle industry without Western help. The Fiat-equipped VAZ plant, for example, produced one-half of all Soviet passenger cars when it came fully onstream in 1975; and the Kama River Truck Plant, which is based almost exclusively on Western equipment and technology, now supplies nearly 50 percent of Soviet output of heavy trucks.*
- *Large computer systems and minicomputers of Western origin have been imported in large numbers—1,300 systems since 1972—because they (a) have capabilities that the Soviets cannot match and (b) use complex software that the Soviets have not developed.*
- *Gear-cutting machines of US origin have been used to produce military trucks, wheeled armored vehicles, and components for missile transporters, and US technology acquired for the Cheboksary tractor plant was used to make a new 12-cylinder tank engine.*

This weakness results, in part, from the absence of a single body to coordinate the diffusion process. The State Committee for Science and Technology supervises interbranch R&D, but its authority ends with the preparation of a prototype; Gosplan handles the serial production and distribution phases. With this split, each organization under the nominal supervision of the GKNT or Gosplan has tended to become parochial, creating barriers that inhibit the movement of an idea through the stages from concept to production.

Implications

The extremely slow pace at which imported Western technology is generally assimilated and diffused in the USSR sharply limits its contribution to the modernization of the Soviet economy as a whole. Even in some high-priority civilian areas—such as imported gas-lift equipment used to maintain or increase oil well flow rates—the protracted delays in acquiring and installing the equipment have reduced the effectiveness of its use.[10]

As the pinch on the USSR's labor, capital, and natural resources tightens and the leading edge of Western technology continues to advance, the Soviets will continue to import Western technology and equipment to alleviate bottlenecks and modernize domestic industries. Even though effective diffusion of technology might occur more quickly through indigenous development, Moscow will continue to rely on imports because the USSR puts a greater premium on satisfying current requirements for equipment and technology than on potential long-term uses

As in the past, some of these imports will raise the technological level of specific industries and/or increase the quantity and quality of their output, and some may find application in Soviet weapons production (see inset)

Nevertheless, Moscow will find it increasingly difficult to catch up with the general level of technology in advanced Western countries by relying on imports of Western plant and equipment. This is partly because some imports embody technology that is not state of the art and are bought simply to improve the average quality of the USSR's own plant and equipment. Even if the Soviets choose the most up-to-date technology, however, imports stand little chance of eliminating the Soviet lag behind the West, because:

- Widespread application of such imports probably will be rare.
- If effective application ever occurs, it is likely to take many years.
- Soviet engineers, having not gone through the designing experience that underlies the imported equipment, will be ill prepared to carry the embodied technology to a still more advanced level

[10] In 1978 the Soviets contracted with a French firm (Technip) to install gas-lift equipment in 1,800 wells at Samotlor—their largest oilfield. Similar equipment was purchased for 600 wells at the Fedorovo field. Completion of these projects was scheduled for 1985 but has been delayed for a year or two. If installed on schedule, this equipment could have provided some 200,000 to 300,000 barrels per day of oil output beyond that otherwise expected from these fields. Because of the delay, however, the window of opportunity for the most effective use of this equipment may have been missed, because the water cut (the amount of water mixed with the oil) at Samotlor and Fedorovo is now higher than optimal for extraction by gas lift