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Gorbachev's Factory Modernization Initiative: Machine Building as a Case Study [redacted] 25X1

A Research Paper

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Gorbachev's Factory Modernization Initiative: Machine Building as a Case Study

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A Research Paper

This paper was prepared by the Office of Soviet Analysis. Comments and queries are welcome and may be directed to the Chief, Defense Industries Division, SOVA

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Gorbachev's Factory Modernization Initiative: Machine Building as a Case Study

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Scope Note

This Research Paper examines and evaluates progress in Gorbachev's program to modernize factories. It focuses primarily on his push to move advanced production technologies to the factory floor in the civil machine-building sector. It does not address the state of specific technologies,

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In this paper we examine Soviet factory modernization options, address how factory modernization decisions were made before Gorbachev became General Secretary, and note how his initial programs affected this process. In doing so, we use the civil machine-building sector as a case study, both because of its crucial role in modernization and because Gorbachev's initiatives affect it disproportionately. We then analyze the impact that proposed changes in areas such as central planning, price formation, and wholesale trade are likely to have on the factory modernization management process. The paper puts special emphasis on the interaction between traditional, highly centralized administrative measures and the decentralizing reform program and its impact on factory modernization during the 12th and 13th Five-Year Plans.

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Gorbachev's Factory Modernization Initiative: Machine Building as a Case Study

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Summary

Information available as of 6 October 1988 was used in this report.

Gorbachev understands that the rapid introduction of new and more appealing consumer goods, higher quality industrial products, and modern weapons requires the installation of new equipment on the factory floor. The bulk of this new equipment must be produced in the USSR's own machine-building factories. Following a strategy first outlined in his address to the June 1985 Science and Technology Conference, Gorbachev is directing resources first toward the renovation of these machine-building factories in the hope they then can provide the advanced equipment needed to upgrade factories throughout the rest of the industrial sector.

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Gorbachev's strategy puts machine builders under intense pressure to achieve ambitious but contradictory goals. They are to modernize their own factories while simultaneously increasing the quality and quantity of their output. To do this they will have to use the best of existing production lines more intensively, while replacing obsolete ones at a breakneck pace. To implement this strategy, civil machine building has been tasked to:

- Raise investment from 35 billion rubles in 1981-85 to 63 billion rubles in 1986-90.
- Increase renovation expenditures by 100 percent during 1986-90, to a total of 30 billion rubles.
- Raise the annual retirement rate of the machinery component of its fixed capital from 2.3 percent in 1985 to 9.7 percent in 1990.

As a consequence of these actions, the share of equipment in Soviet machine building that is newly installed each year is supposed to rise dramatically (see figure 1) to create a more modern, efficient, and flexible production base able to provide the new, technically advanced machinery needed to modernize other Soviet industrial facilities.

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One way to modernize existing factories is to "reconstruct" them. This involves removing entire sets of old production lines and replacing them with new ones incorporating advanced technologies. Gorbachev prefers this approach because it creates opportunities to make sharp improvements in both production processes and products while avoiding the costs associated with plant expansion or new plant construction. Reconstruction also permits him to direct scarce construction resources into housing and services and avoid making the politically unpalatable choice between consumer well-being and industrial modernization.

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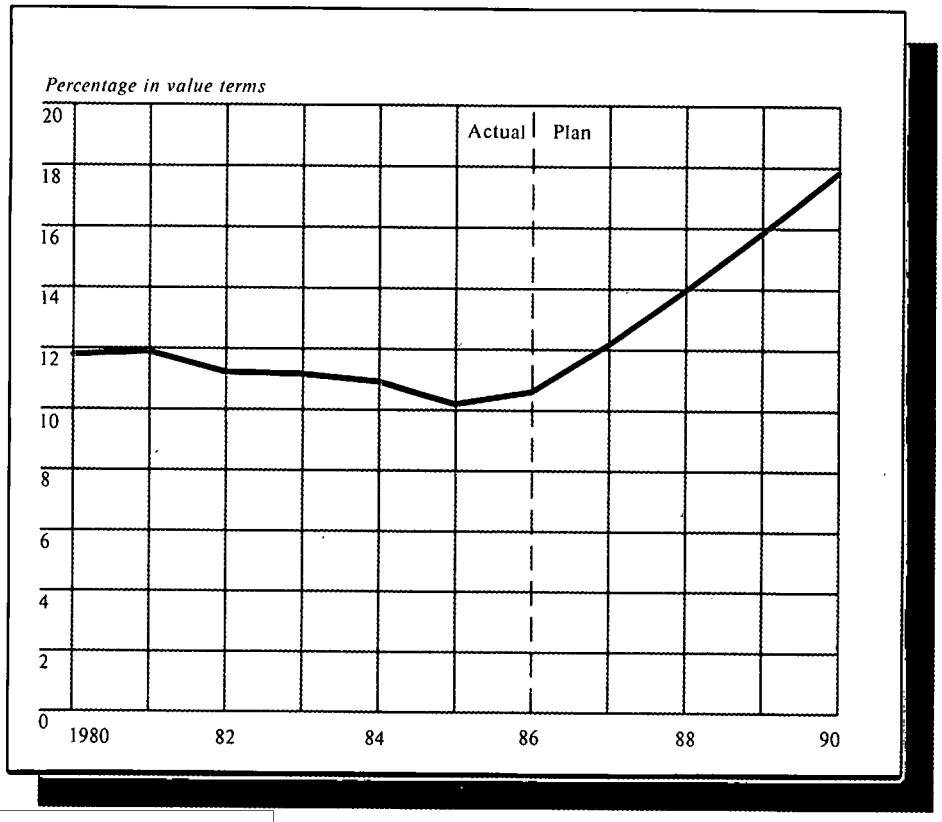
Figure 1
Percentage of Equipment New Each Year in Soviet Civil Machine-Building Enterprises, 1980-90



Gorbachev has borrowed several procedures from the defense industry to encourage enterprises to increase the amount and accelerate the pace of reconstruction. Foremost among these is the mandate to begin what the Soviets call technological preparation for production (retooling to produce new products) much earlier in the civil product development cycle. Gorbachev has also ordered increased standardization of products and components, higher priority for reconstruction projects, better process and project planning, and a transition to double and triple shifts—in the hope

that enterprises will maintain production using their most advanced equipment while reconstructing some of their facilities. These changes—all of which strengthen central planning—could improve product, process, and project design but will take several years to show substantial results. 25X1

Rather than relying solely on direct orders, Gorbachev is also trying to give enterprises financial incentives to reconstruct by decentralizing the economic system:

- As of 1 January 1988, industrial enterprises were to finance much of their current and capital expenditures from sales revenues and other internally generated funds—instead of relying on Moscow to provide financing.
- Selected industrial enterprises are now permitted to keep the bulk of the hard currency profits they earn through exports to spend on imported machinery and equipment for factory renovation.

These measures, however, will not be fully implemented until 1991, when the 13th Five-Year Plan (FYP) goes into effect. 25X1

Despite the flurry of reform initiatives emanating from Moscow over the past three and a half years, the current FYP was conceived as and remains primarily a traditional one, governed from the center. The same incentives and pressures that doomed past efforts at reconstruction continue to dominate enterprise managers' decisionmaking. Further, the effects of partial reforms now in place are being negated as ministries continue to meddle with and redistribute enterprise funds earmarked for renovation. Moreover, enterprises find it difficult to locate capital goods to purchase with their remaining funds because equipment sales are directed from the center. 25X1

The primary result of the conflict between the traditional economic system and Gorbachev's factory modernization initiatives has been to enhance rather than to remove incentives for enterprises to engage in reequipping—the less effective, piecemeal replacement of individual machines—rather than reconstruction. Because so little has changed with respect to the decisionmaking process and the incentives affecting these decisions, Soviet performance in machine-building plant renovation during Gorbachev's first years has been poor, largely reflecting a continuation of the problems inherent in centrally administered renovation:

- In June 1987 70 percent of renovation investment provided "zero" return because it was merely reconstruction for the sake of reconstruction. 25X1

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- By the third quarter of 1987, 60 percent of the renovated plants surveyed in Leningrad had unspecified problems reaching planned production levels.
- In Leningrad, many machine-building ministries have put off renovation plans until 1990 after sharply slowing the growth of investment dedicated to renovation in 1987.
- In February 1988, three Soviet economists admitted in a *Planovoye khozyaystvo* article that the renovation of machine building "is in a state of serious disruption."

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If Gorbachev decides that factory modernization requires a higher priority, he could take further administrative actions to give it a one-time boost:

- He could slow new housing construction and use the resources freed to expand existing factories or build new ones. This option is unlikely given Gorbachev's highly publicized commitment to increasing the amount of housing and other facilities for consumers.

- He could reduce planned investment in other sectors of the economy, such as agriculture and energy. This option is appealing, given the poor return on investment in these sectors, but would threaten both the energy and food program goals.

- He could scale back factory output goals, provide breathing room for effective reconstruction, and import machinery to replace the shortfall in domestic production. However, the risk of piling up a huge foreign debt to create new factories is probably too great for Gorbachev, and he is not likely to choose this option.

- He could cut defense spending and use the freed resources to promote better technical reequipping and reconstruction. Gorbachev's public statements indicate some sympathy for this option.

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None of these actions would lay the groundwork for a fundamental improvement of the modernization process because they do not address enterprise managers' incentives and freedom of action. Moscow's longer term challenge is to strike balances between a new set of incentives provided by decentralizing, financial reforms, and the directives provided

by a reduced but still powerful central administrative apparatus. These diverse pressures find their focal point in industrial prices. To make a decentralized, reformed industry meet his centrally set goals, Gorbachev must simulate a competitive setting and create a price formation calculus that simultaneously ensures enterprises:

- Make the "right" choice between current production and modernization.
- Have the incentives to develop and disseminate products incorporating new technologies.
- Can bid for essential high-quality raw materials and intermediate inputs—priority goods that traditionally have been administratively allocated to the defense sector. 25X1

We believe setting "correct" prices to fulfill these criteria will be almost impossible. Soviet central planners have never been able to find prices that simultaneously promoted these goals, and Moscow's retention of substantial administrative levers to guide investment is, by itself, an implicit admission that they do not expect to arrive at "correct" prices even after implementing the next round of reforms. 25X1

In the absence of such systemic change and relaxation of taut planning targets, Gorbachev's program is likely to provide only modest improvements. The use of reconstruction as a common method of modernization is unlikely until Moscow's power to administer factory output and technological design is reduced. Until then, most factory renovation will continue to take the form of reequipping, and new machinery models will be only incrementally better than those they replace. Thus, Gorbachev's attempt to modernize the civil machine-building production base—while making some progress—is unlikely to provide the hoped-for gains in efficiency, improved product quality, and production levels, nor will it result in the modernized technological base planned for civil machine building by 1990. As a result, we believe broader industrial modernization—a process dependent on the availability of more and better machinery and equipment—will fall far short of plan. 25X1

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Introduction

Gorbachev inherited an aged and inefficient civil industrial base. Successfully modernizing this base requires installing massive quantities of machines incorporating advanced manufacturing technologies. Civil machine building, itself in need of modernization, has been tasked with providing most of this advanced equipment. The fate of the Soviet modernization program thus rests, in large measure, on the ability of the civil machine-building complex to produce new and better products, and more of them.

But modernization requires that the distribution, installation, and integration of these advanced machines in new and existing factories be well managed. Unfortunately Gorbachev also inherited a system in which Moscow bureaucracies, rather than enterprises, control most investment decisions. This excessive centralization and the entire economic milieu it created undercut earlier drives to improve Soviet industrial productivity. Gorbachev has appropriately initiated a sweeping program to decentralize parts of this process to change the basic incentive system that determines how the Soviet economic system functions. Ultimately, civil machine building's ability to modernize depends on whether changing investment incentives permit it to choose and use its own production more efficiently.

Gorbachev's Resource Allocation Dilemma

Gorbachev intends to modernize the Soviet economy by upgrading existing enterprises rather than building entirely new ones. Soviet economists typically claim that the return on a ruble spent on renovation is twice as great as that of a ruble spent on new construction. The primary reason for the greater economic returns from renovation is that resources—metals and construction materials—are saved by not constructing new factories and supporting infrastructures. Plant expansion is a middle option. While it requires approximately the same amount of material per cubic meter to expand a factory as it does to build a new one, expansion maintains existing work forces and avoids the large infrastructure investment (transport, power, and services) often required to develop new production sites. By pursuing factory renovation rather than construction of new factories, the leadership thus hopes to attain its modernization goals without having to allocate scarce investment and labor to the construction and construction materials sector.[1] [2]

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Options in Modernizing Existing Plants

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Existing enterprises can be modernized by three general methods: reequipment, reconstruction, and expansion. Each has a distinct and separate meaning in formal Soviet economic usage. However, expenses for the first two are grouped in one category—renovation—in statistical reporting.

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Reequipping. Reequipment is the straightforward replacement of machinery—either individual machines or entire assembly lines—with more advanced machines that have technical characteristics similar to the machines they replace. A simple example of reequipment would be replacing an old model electric typewriter with an advanced electric typewriter that has self-correction, memory, and a program to check for spelling errors. The expenses for construction and installation work during technical reequipment are generally small—Soviet guidelines limit its share in total expenses to 10 percent—and often no additional construction and installation work is required.

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[1] Indeed, if the renovation component of the economywide modernization program of the 12th Five-Year Plan (1986-90) were implemented according to plan, the Soviets could save construction resources equal to those used in building all the new housing commissioned in 1987.

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[2] Gorbachev has publicly disavowed the strategy of extensive growth.

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Reconstruction. Reconstruction generally involves more construction and installation work than reequipping. An example of reconstruction, continuing the analogy, would be the replacement of typewriters with networked personal computers and high-speed printers, a procedure necessitating installation of ductwork and hardwiring to connect the PCs to each other and the printers. While upgrading a typewriter with a new model increases the speed with which accurate letters can be typed, installing PCs and printers does this and permits desktop publishing of pamphlets and graphics as well. Under Soviet guidelines, reconstruction may include the expansion and even new construction of auxiliary and service facilities. The economywide share of outlays for construction and installation work in total reconstruction expenses averaged 20 to 25 percent in the early 1980s; the current guideline is 35 percent.[3]

Expansion. Expansion involves additions to existing buildings and requires more construction and installation work than does reconstruction. Indeed, the share of expenditures for construction and installation work in total expenditures for expansion is about 60 to 70 percent. However, the work tends to be simpler and easier, primarily because standardized construction techniques and kits can be used. Also, properly planned expansion can take place without disrupting existing production and without modifying existing fixtures. Expansion, moreover, permits managers to retain obsolete equipment for emergencies, whereas reequipping and reconstruction displace obsolete equipment. The principal disadvantage of expansion is that it is a costly and lengthy process. According to State Committee for Construction (Gosstroy) chairman Yuriy Batalin, major construction projects now take the Soviets about eight to nine years to finish. Major expansion of existing enterprises can take about as long, although, in their extensive review of Soviet literature on construction, Western scholars Vladimir Kontorovich and Boris Rumer determined that typical project completion times for medium-sized reconstruction projects were three to four years. Even medium-sized reconstruction projects at machine-building plants could take longer than this average, however, because of the special nature of machine-building plants' physical layout (see inset).

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The Pre-Gorbachev Factory Modernization Procedure

Factory modernization ranges from fairly simple to quite complex, depending on whether the factory is undergoing reequipping or reconstruction. The latter is by far the more complex, because the factory typically attempts the introduction of new products and manufacturing processes simultaneously and without reducing current production levels.[4] Further, the approval procedure for reequipping, where individual projects are smaller, can be simpler and more straightforward than the often cumbersome approval procedure for major reconstruction projects.

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The Investment Planning Procedure

The formal planning procedures for reequipping and reconstruction have much in common. Planning begins by reviewing the enterprise passport—the card files listing all fixed capital belonging to an enterprise and its current state of repair. Enterprise managers then project which machines or assembly lines need to be replaced during the forthcoming annual and five-year plans.

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Enterprises are supposed to select the most advanced equipment available, using published state standards (GOSTs) and foreign trade publications to determine what new machinery models should be chosen to

[3] In this example, there is a good chance that in the process of laying extensive new wiring for the PC network, existing phone lines and electric powerlines must be moved, or if they cannot be moved, that inefficient and convoluted paths will be required for the new PC wiring. Analogously, Soviet machine-building enterprises often have massive concrete and reinforced concrete foundations and huge overhead crane systems that tend to make both the planning for reconstruction and the reconstruction itself extremely difficult.

[4] Soviet product renewal usually involves substantial changes in the technological content of the factory's output rather than simple expansion of product lines: for example, switching to the production of color TVs rather than introducing new black and white models. Although a factory can undergo reconstruction to produce the same product more efficiently, in most cases reconstruction precedes major changes in the product.

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Machine Building's Special Reconstruction Problems

Soviet economist Viktor Krasovskiy notes that renovation requires work in cramped industrial premises, the use of intraplant transport mechanisms and specialized construction equipment, and detours around various communication and underground structures. A Gosstroy department head notes that organizing construction simultaneously with production is considerably more complex than organizing just new construction because of the difficulties in sharing the use of overhead cranes, switch engines, power, transport, and administrative and cultural resources. Other Soviet economists claim reconstruction is hindered by severe shortages of skilled labor and specialized equipment.

While these problems hold true for reconstruction in general, machine-building plants tend to be especially cramped. Fully mechanized work is impossible, so the work is only partly mechanized. This requires even greater quantities of less powerful equipment for foundation pit excavation, dismantling concrete and reinforced concrete components, and replacing crane beams. Factory workers and construction workers interfere with each other's work, and so the renovation process can extend over "several decades."

replace those scheduled for removal. Enterprises then estimate the projected growth in productivity that should result from installing new equipment. The enterprise is also supposed to look for machines whose replacement would increase productivity, reduce manual labor, or improve worker safety, regardless of the equipment's age. The enterprise then decides whether reequipping or reconstruction is best for its needs and submits its projected modernization plan (and the resulting output plan) to its ministry for approval. All of this planning is done in accordance with the basic regulations contained in the appropriate set of methodological instructions published by central planning organs.

The ministries then review these plans before they are finally coordinated by the State Committee for Planning (Gosplan). When plans call for machinery models already in serial production, Gosplan incorporates the production of these models in the annual plans of the appropriate machine-building plants. They are then delivered through the State Committee for Material and Technical Supply (Gossnab) and paid for out of the State budget, the ministerial budget, or the enterprise's own production development fund (PDF). If equipment is imported, and the enterprise has its own hard currency account (to buy equipment from the West) or bilateral trade account with an East European country, only ministerial approval is needed, and Gosplan and Gossnab should not be involved. 25X1

While the planning procedure is simple in theory, circumstances may frustrate fulfillment of a plant's original plans whether they call for reequipping or reconstruction. For example, a plant may identify a need for capital equipment not yet in serial production. Coordination and planning of the design, development, and production cycle for new equipment can last decades (see inset). Gosplan and ministries then face the choice of accepting lengthy delays or modifying the original plan to include less advanced equipment. Generally, they modify the plan and use whatever equipment is available, rather than accept delays induced by the design process. 25X1 25X1 25X1

Moscow will often be able to provide a close substitute for the originally envisioned equipment because the Soviet practice of making incremental changes to equipment models makes it likely that some more advanced version of needed equipment is nearing the end of development. In addition, newly designed capital goods created under the all-encompassing system of GOSTs are usually similar enough to previous models to reduce the need for redesign of the production line or facility.[5] 25X1

[5] The common practice of making cosmetic—as opposed to real but incremental—changes to machinery models and claiming that they are new models can also explain the ease with which some old models can be replaced by new models. 25X1 25X1

Soviet Product Design

The design and development procedures for a new product have several major defects. The first is poor Soviet design work. Boris Rumer cites Soviet surveys showing that only 20 percent of Soviet designers can design a simple part and only 5 percent can design a complete, simple machine tool. Ukrainian party boss Vladimir Shcherbitskiy claims that only one out of eight machine-building design institutes in Kiev completes designs that exceed world or Soviet standards.

Soviet designers are not entirely at fault for poor design work. They must comply with hundreds of thousands of inflexible state standards [a] for various machines and must attempt to use as many standard parts as possible in their new products—and all the while try to introduce progressive and modern designs. Designers are hampered by shortages of computers,[b] which lengthen each stage of the design process, and multiple layers of bureaucracy, which introduce frequent changes in the project design requirements. Two separate Soviet sources have claimed that over 100 signatures are needed to approve new machines, and one of these sources estimated it required two to three years to collect the needed signatures. Vasil'yev adds that "designers most often end up as fixers or couriers collecting authorizations." In addition, designers must provide extensive documentation at each stage of the process. Completed designs require instructions for workers that run 50 to 60 pages, while comparable Western documentation is usually only one page in length. Consequently, it now takes 12 years to create new tractors and nine years, on average, to create other agricultural machines. While some of the showcase enterprises, such as Ivanovo, claim they can create new machine tools in about a year, at others, such as Uralmash, some 40 percent of the designs take five years or longer to complete. 25X1

In July 1988 Moscow initiated a program to speed the development of promising machinery designs for 44 "priority directions." Though details of the plan are sketchy, machines designed for priorities such as the food program, transportation, construction, and consumer services are to be developed only if they meet specific customer requirements. Unpromising designs are to be eliminated, and resources concentrated on the priority directions. Research and design institutes have been promised additional computers and test-base equipment, but rapid improvements to the test base are not likely without substantial assistance either from the West or the defense industries. 25X1 25X1 25X1

[a] *Lev Vasil'yev, the former minister of the now disbanded Ministry of Machine Building for Light and Food Industry and Household Appliances, said that designers in his ministry were "forced to comply with state standards for products established in the fifties and even in the forties."*

[b] *Vasil'yev maintains that design "work organization is routine and is not automated. The capital:worker ratio of a designer's workplace is 'peanuts.'"*

The most frequent reason original renovation plans are modified or delayed is excessive bureaucratic coordination and review. even the preliminary discussions between an enterprise and its ministry over the general directions of proposed renovation projects can drag on for years.[6] *Pravda*, for example, complained that the management of the Krasnyy Proletariy Machine-Tool Building Association and its parent ministry spent "months and years in endless coordination" planning the renovation of the old Krasnyy Proletariy factory. But resolving the differences between an enterprise and its ministry can mark just the beginning of the review process. In general, the more expensive and complex a proposed project is, the more extensive the review process becomes. Reconstruction projects tend to be 25X1

[6] Professor Judith Thornton, University of Washington, report on the Soviet Interview Project to the Department of State (19 February 1987). 25X1

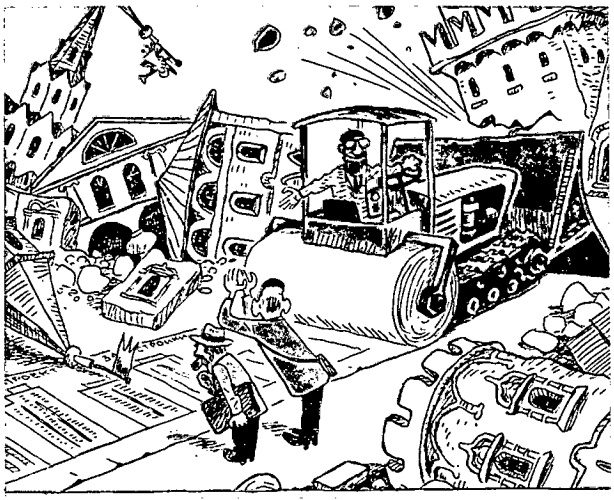


Figure 2. Clearing a path for the project.

larger than reequipping projects, and those costing more than 4 million rubles require Gosplan review and approval.[7]

Renovation may also be delayed by changes in the bureaucracy or party intervention. Continuing administrative reorganizations led to project delays at the Leninakam Refrigerator Compressors Plant. It was reorganized nine times in 20 years and although new plans for modernization were drawn up each time, not one was implemented. It still produces obsolete compressors. Party officials intervened in plans to renovate the foundry at the Moscow Dynamo Works when planners failed to consider cultural and environmental concerns . The original plans were sent back when political authorities realized they called for the destruction of the Church of the Birth of Our Lady, founded in 1509 as a monument to the Battle of Kulikovo Field. (This problem is not limited to the Dynamo plant, and cultural or environmental concerns do not always prevail. See figure 2.)

[7] The evidence on this limit is mixed. David Dyker cites claims that Gosplan approval of detailed plans is required for projects costing over 150 million rubles. A Gosplan deputy department chief claimed the limit was 50 million rubles. A 1986 *Ekonomicheskaya gazeta* article claims that review by the State Committee for Science and Technology is required for projects over 100 million rubles. However, Dyker also cites an *Ekonomicheskaya gazeta* source that states every project proposal must have a "title list"—a document of about six pages detailing the main technical characteristics of a project. Gosplan reviews the title list of all projects with estimated costs over 3 million rubles. Review authority for projects costing less than 3 million rubles is vested with the ministry and/or local or republic party or government authorities. Gosplan review is also required for technical reequipment projects where the planned expenses for construction and installation work exceed 10 percent of the estimated cost.

Cheap at Twice the Price

V. Paschenko, General Director of the Frezer Production Association:

> At the end of last year we failed to take delivery of a number of machine tools, and as a result of this we underfulfilled our reequipping plan by 300,000 rubles. The rayon party committee mercilessly took us to task for this, and we did not know where to turn. When suddenly, instead of the machine tool which we had ordered and which cost 40,000 rubles each, machine tools costing 100,000 rubles arrived, we were very happy and reported the fulfillment of the re-equipping plan.

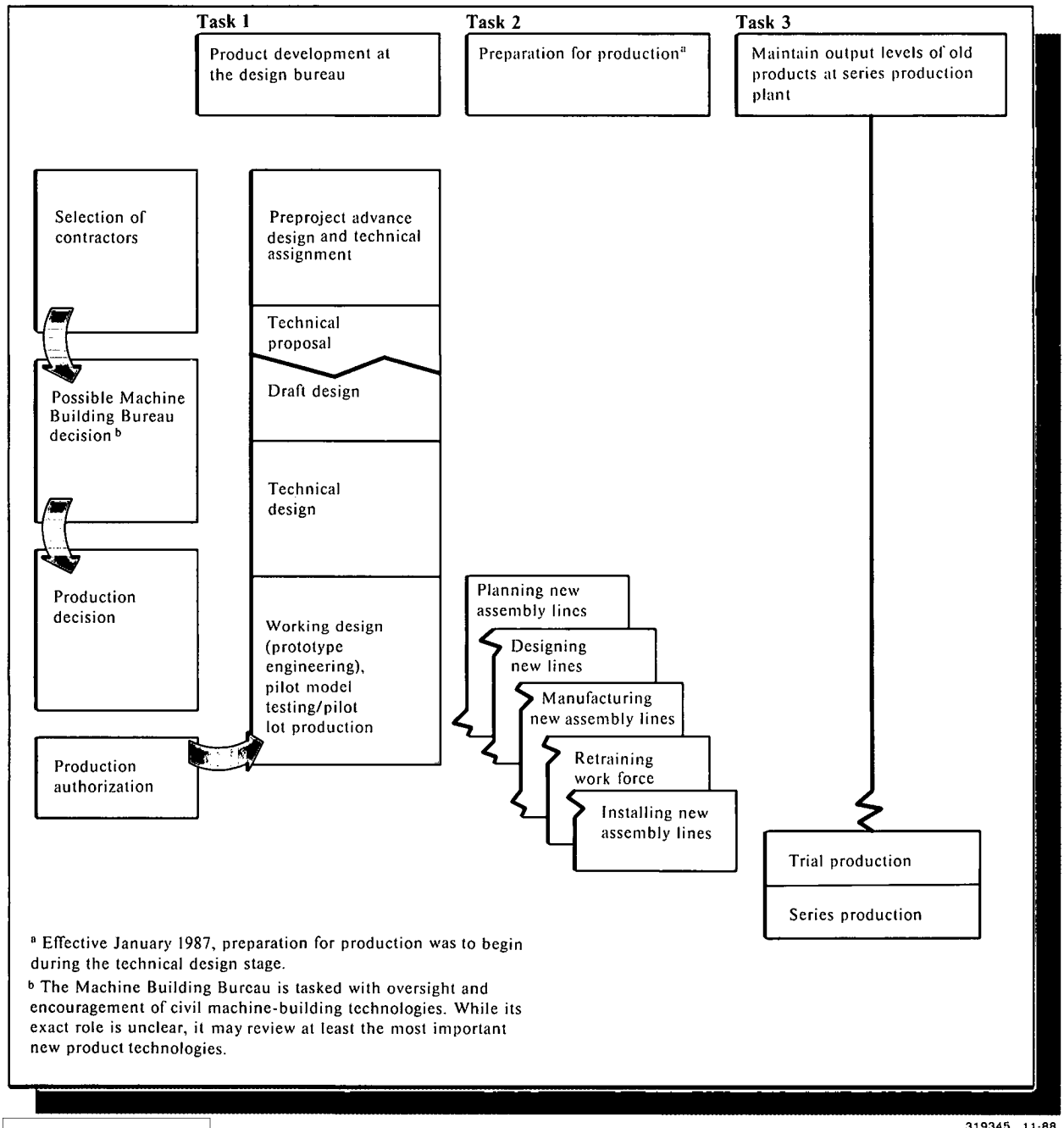
A final problem stems from the vagaries of the central distribution of capital goods. Regardless of what is ordered, enterprises cannot be certain what equipment will be delivered and when it will arrive (see inset). The equipment they get may be quite different from the original specifications, so they seldom take steps to prepare to install new equipment before its arrival. If the plan called for reequipment, these delays should be minor because the construction and installation work involved in reequipment is minimal. Enterprises initiate the reequipment process to solve existing or potential problems, so they tend to install whatever is delivered.

The Reconstruction Procedure

Reconstruction of an existing enterprise generally is undertaken as part of a more general preparation for the production of a new product. This includes three separate, yet interconnected, tasks:

- First, a proposed new product must go through the normal design and development procedures before it is certified as ready for series production.

Figure 3
USSR: Product Development and Production Preparation



[a] Effective January 1987, preparation for production was to begin during the technical design stage.

[b] The Machine Building Bureau is tasked with oversight and encouragement of civil machine-building technologies. While its exact role is unclear, it may review at least the most important new product technologies.

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- Next, new assembly lines needed to produce this new product must be planned and installed in the factory (actual reconstruction).
- Finally, current production of old products must be maintained while the installation of the new assembly lines is accomplished (see figure 3).

Reconstruction is usually a prolonged process. Most assembly lines are individually designed, and the design and manufacturing process takes from three to five years. Until January 1987 this process did not begin until the new product the lines are to produce has itself been designed. (See page 10 for Gorbachev's plan to accelerate this process). These lines are often ordered through Gosplan or the Council of Ministers, so the process of getting the order placed probably begins several years before the design and manufacturing stages. Sometimes a ministry will refuse to push for new assembly lines—if it is responsible for acquiring the lines—making it impossible for a plant to renovate. The Leningrad Reductor factory was saddled with obsolete equipment, was deeply in debt, and was tasked with an unachievable plan. Although the Ministry of the Machine Tool and Tool Building Industry (Minstankoprom) promised reconstruction with automatic lines and flexible automated production, it never delivered, preferring that the plant meet its plan using overtime.

Next, when the new equipment arrives at an enterprise, it must be installed quickly so as to limit disruption of current production. But ministries and higher authorities must approve the installation plans, and sometimes they make changes even after new equipment has arrived. The first secretary of the Kirovabad Party Committee complained that the Ministry of Instrument Making, Automation Equipment, and Control Systems amended the planning estimates for the installation of equipment five times in two years.

The erratic allocation of capital equipment also hinders reconstruction more than reequipping. For example, the delivery of a manually operated Mark III lathe instead of a computer numerically controlled Mark V model need not be a problem in a reequipping plan. However, if reconstruction plans envision a flexible manufacturing system including the Mark V lathe, delivery of the Mark III can prove to be a major impediment. If the original plan is not revised or delayed (until the right model is delivered), payoffs from the project will be minimal. 25X1 25X1

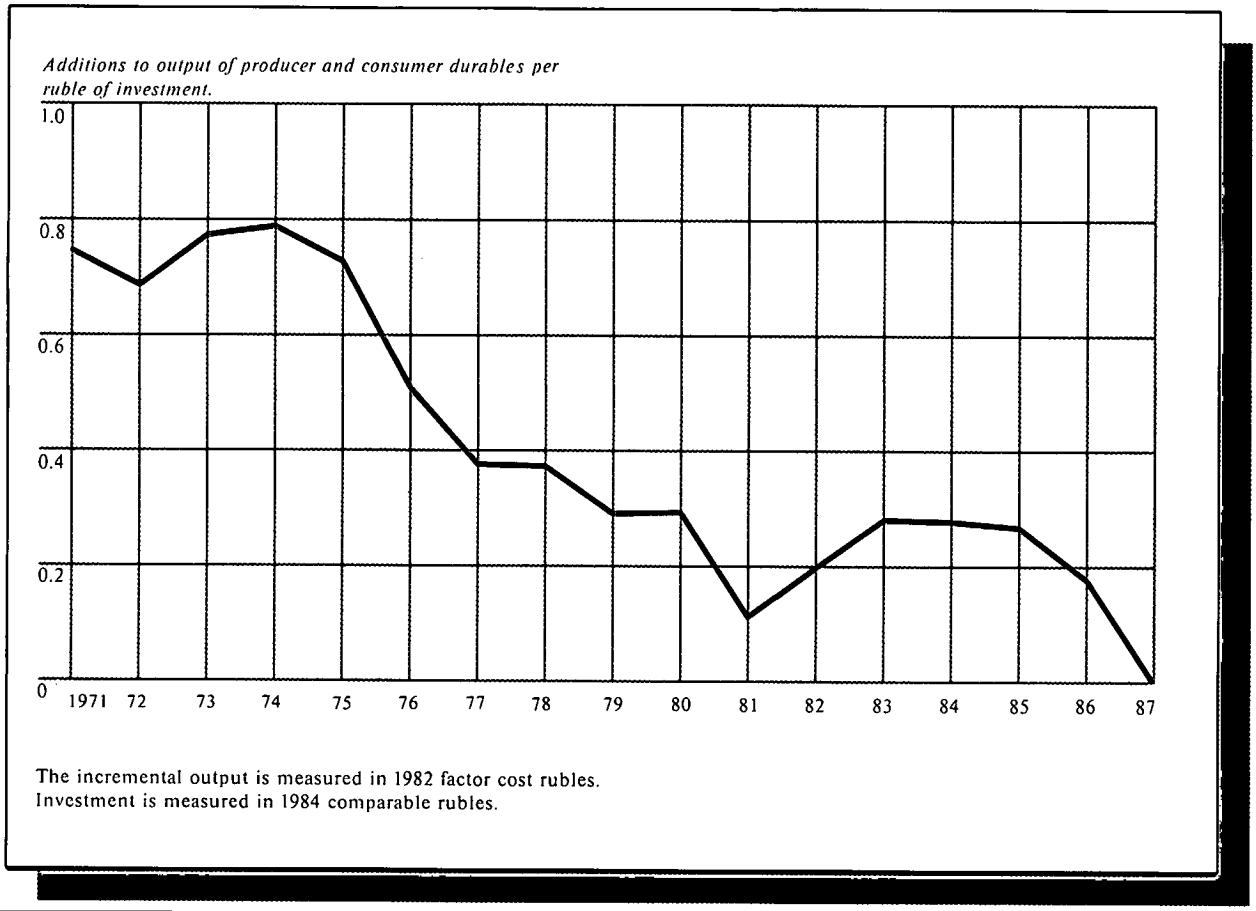
Renovation Thwarted

Previous efforts to boost economic performance by modernizing machine building via extensive renovation—beginning with Brezhnev's renovation campaign in the mid-1970s—were in large part limited by the incentive system and administrative apparatus described above. As a result, the returns on investment in civil machine building fell dramatically (see figure 4). Soviet incentives clearly encouraged current production at the expense of renovation when enterprise managers faced conflicting plan directives to produce and modernize simultaneously (see inset, page 9). 25X1

Many managers are not willing to put current production schedules at risk and use three strategies to evade conflicting directives:

- They meet renovation goals through reequipping rather than reconstruction. A Soviet specialist claims that, while in 1976 about 45 percent of machine building's renovation expenses were for technical reequipment, by 1986 the percentage had grown to almost 95 percent. 25X1
- They misclassify expansion or new construction as enterprise renovation. A Moscow city party official admits "it is no secret that, despite the ban on new [primarily industrial] construction, the building of more and more new projects is continuing under the guise of renovation." 25X1

Figure 4
Incremental Output/Investment Ratio in Soviet Civil Machine-Building Ministries



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- When reconstruction is unavoidable, they undertake minimal amounts of reconstruction every year—enough to claim they are trying, but not enough to interfere with ongoing production. Soviet planning officials term this process "crawling reconstruction." Enterprises are willing to fail to meet their reconstruction plan and suffer a minor loss of bonuses, rather than fail to meet their output plan, with the far more severe consequences that entails.

Because enterprises undertake reequipping rather than reconstruction, modernization is slowed, with benefits often being limited by the physical attributes of a building and the piecemeal nature of reequipping.

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during the period 1981-84 reequipping was more effective than reconstruction only in the Ministry of the Machine Tool and Tool Building Industry; it was less effective than reconstruction in the five other machine-building ministries

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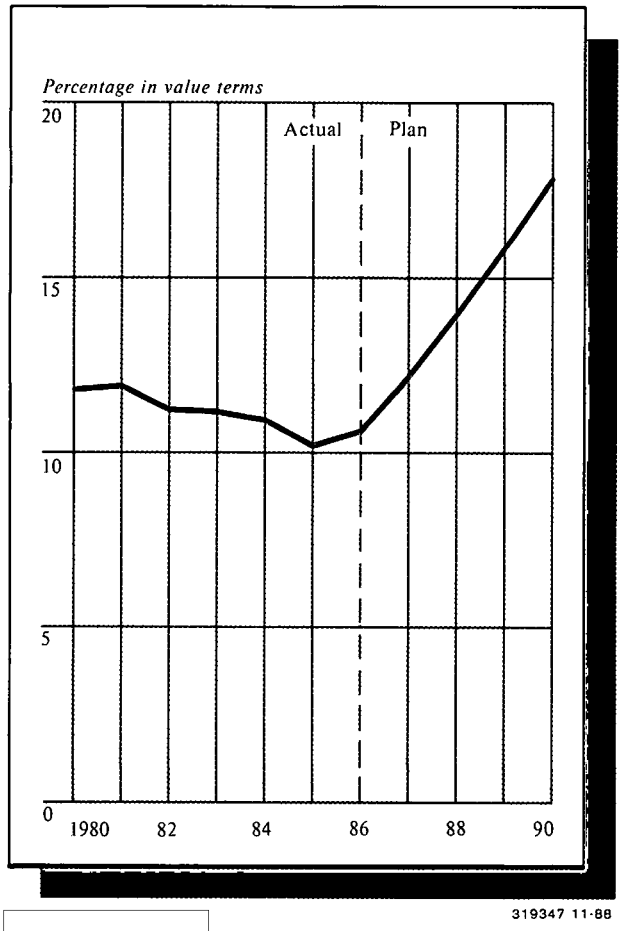
Plant Caught Between Scylla and Charybdis

The Dimitrov Milling Machine plant was described by a first deputy minister of Minstankoprom as "a collection of dog kennels." Reconstruction and later expansion was deemed vital. Thus, the Dimitrov Plant, in conjunction with two state institutes, developed a program to introduce the manufacture of electronic bracket milling machines. Minstankoprom approved the program and ordered it to be implemented in 1986.

A production preparation planning schedule was developed. Equipment accessories were designed; specific metals and auxiliary equipment were ordered. The equipment arrived and reconstruction was ready to begin. For reconstruction to take place in 1987, however, Dimitrov had to cut its output of universal machine tools from 3,000 units in 1986 to 1,500. The week before Ministankoprom confirmed the reconstruction program, it also ordered Dimitrov to increase production of universal-type machine tools from 3,000 to 3,190.

for which data were available. an enterprise cannot remain permanently young through technical reequipment." Complaints by Soviet leaders also testify to reequipping's increasing lack of economic effects. In 1986 almost 70 percent of renovation expenditures were spent to replace worn-out equipment with new but similar equipment.

Figure 5
Percentage of Equipment New Each Year in Soviet Civil Machine-Building Enterprises, 1980-90



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Gorbachev's Modernization Program

Gorbachev's preferences with regard to the mix of reequipping, reconstruction, and expansion are clear: he is pressing civil machine builders to choose more reconstruction and less reequipment and expansion. These wishes were echoed by Viktor Krasovskiy, who declared that "the present-day tasks of machine building are not to deliver equipment 'piecemeal' to projects, but the organized installation and skilled adjustment of entire systems of machines and equipment of shops and production operations."

Following a strategy first outlined in his address to the June 1985 Science and Technology Conference, Gorbachev is focusing first on renovating the machine-building complex, which he hopes will then be in a better position to provide new, technically advanced machinery to refurbish the remainder of the

Soviet economy (see figure 5). Total economywide renovation in the 1986-90 FYP is planned at 232 billion rubles. To implement this strategy, Gorbachev has instituted both administrative and decentralizing reform measures to get civil machine building to:

- Raise investment from 35 billion rubles in 1981-85 to 63 billion rubles in 1986-90.
- Increase renovation expenditures by 100 percent during 1986-90, to a total of 30 billion rubles.
- Raise the retirement rate of the machinery component of its fixed capital from 2.3 percent in 1985 to 9.7 percent in 1990.

New Administrative Measures

Gorbachev has mandated several administrative measures to accelerate factory renovation. First, he tightened centralized investment project review to concentrate investment resources in major reconstruction projects associated with the introduction into production of new, technologically advanced products. Next, he borrowed from the defense industries the system of simultaneous product design and technological preparation for production used in weapons development. He also initiated measures designed to break information bottlenecks and to increase the use of production lines remaining in operation at facilities undergoing renovation.

Improved Project Selection. Gorbachev hopes that by rejecting investment projects incorporating obsolete technologies and by giving reconstruction priority over new construction he can concentrate investment resources on technically advanced projects and reduce construction times by a factor of 3 to 4. To ensure that new projects merit funding, he increased the rigor of reconstruction project review by Gosstroy and the USSR Industrial Construction Bank (Promstroybank) and expanded the review of specific technologies by the State Committee for Science and Technology (GKNT) and the People's Control Committee. In December 1987 Nikolay Slyunkov, the party secretary overseeing the economy, asserted that only 10 percent of the 1,500 modernization projects reviewed by Promstroybank met world standards. Similarly, the People's Control Committee inspection of new machine tool models proposed by Minstankoprom for 1986 found that only one-half were better than previous models. In addition to tighter project and design review, Gorbachev rearranged priorities among the remaining projects. A March 1986 joint CPSU Central Committee/Council of Ministers decree directed all ministries, departments, and party organizations to accelerate scientific-technical progress through major reconstruction of factories. Whereas previously new construction had priority for new equipment, priority was now given to renovation. 25X1

Emulating the Defense Industry. Gorbachev also altered the renovation planning process to bring it closer to the defense industrial preparation-for-production model (see table 1). Several of the changes in the planning of enterprise reconstruction appear to have been lifted directly from the preparation-for-production process used in the defense industries. Many of these changes will affect both the reequipping and the reconstruction processes. 25X1

Accelerated Preparation for Production. Gorbachev has mandated that production preparation begin in conjunction with product design so that a new product can enter series production as soon as it is fully developed. (The table lists the typical steps in an accelerated preparation for production.) 25X1

the previous system for civil preparation for production "resulted in huge losses of time, which cannot be tolerated by present-day standards." That system called for "work to be carried out in a rigid sequence: technical assignment, design and development, prototype fabrication and tests, and acceptance trials." Production preparation work could begin only after acceptance trials, resulting in a substantial gap between completion of product development and series production of that new product. Beginning preparation for production simultaneously with the formulation of design documentation and the finalizing of test prototypes became the civil standard on 1 January 1987 (see inset). However, civil factories must still maintain current production of new products while preparing the factory for production of old products—a constraint that the defense industrial ministries do not face. 25X1 25X1

Soviet Product and Process (Production Preparation) Development [a]

Stage of Product Development	Production Preparation Activity
Technical assignment Sets out purpose of product, describes technical operational and production requirements, and sets a timeline for product development.	Consider various ways to prepare for production.
	Collect information on production processes and technology that might be used.
	Coordinate the technical requirements of the product.
Technical proposal Outlines proposed design solution.	Identify existing parts or components that can be used in the product.
	Identify alternative ways to assemble new parts and components.
	Examine and confirm the technical proposal.
Draft (preliminary) design First steps of practical design; includes detailed scale drawings and mockups.	Assess the producibility of different parts.
	Assess the design of parts in light of expected operational conditions.
	Check the design for the precision and interrelationship of parts.
	Examine and reconfirm the design documentation.
Technical design Full-scale mockups constructed. Technology is frozen. Mockups tested.	Develop a general plan for preparations to produce the product.
	Develop an organizational structure for managing technological preparation for production (TPP).
	Determine the possibility of parallel and independent assembly and inspection of parts.
	Check the design documentation.
Prototype fabrication	Assess the possibilities for using existing assembly units, structural elements, and materials.
	Examine the design of parts.
	Develop a TPP information model.
	Prepare technical and economic data.
	Determine the machinery and tools to be used in production.
	Determine the installation of production equipment and the organization of the workplace.
	Lay out the production flow through the plant.
	Manufacture special tools and equipment required for production of the product.
	Draft programs for computer solutions to problems.
	Correct technical documents on the basis of computer simulations.
	Develop organizational responsibilities for the management of production.
	Check manufacturing tolerances with tooling specifications.
	Check the possibility of using standard machinery and tools.
	Check the possibility of reducing the amount of machined surfaces.
	Check the ease of inspection and repair of parts.
	Analyze readiness for manufacturing prototype product.
	Check changes in design documentation.
Trial (pilot) and series production	Modify the design to meet production requirements.
	Modify the design for ease of maintenance of parts.
	Check the design documentation.

[a] This outline is based on V. N. Krysin, *Tekhnologicheskaya podgotovka aviatsionnogo proizvodstva* (Moscow: Mashinostroyeniye, 1984), pp. 14-17.

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Comparative Production Preparation Strategies

Preparation for production can begin either simultaneously with product design or after prototype debugging and trial series production have eliminated flaws in the product and the production line. Accelerated production preparation can reduce the time needed to put a new product into series production—if Murphy's Law can be held in abeyance. If, however, planning errors or unforeseen problems crop up, it wastes much early production preparation work and results in costly renovation before the product can be put into series production. Early production preparation also risks locking in production processes that are outdated by the time the product reaches series production.

In the United States, a weapon system usually is completely developed before substantial funding is made available to prepare for manufacturing, although most production design work is completed during weapon development.[a] *This approach decreases the risks associated with production preparation, but it lengthens total weapon acquisition time by adding time between development and production. US civil manufacturers traditionally have preferred to use this same approach when preparing for production. However, increased international competition recently has forced some major manufacturers to use accelerated preparation for production, in spite of its increased risks, in order to get products to the market earlier and maintain market shares.*[b]

The Soviet military uses the accelerated technological preparation-for-production process for weapons development. It has accepted the early technology freeze and the risk of increased production costs, in part because it has been ensured of complementary and follow-on programs to offset the risks of incorporating new technologies. Gorbachev ordered Soviet civil enterprises to use accelerated production preparation beginning in 1987. He hopes that better and standardized design work will both quantify and reduce the risks associated with early production and production technology freezes.[c]

[a] Blueprint for Tomorrow: Joint Air Force and Industry Assessment of the Aerospace Industry Base *(Aeronautical Systems Division, Air Force Systems Command, 16 January 1984), vol. 1, section 2.2.3.*

[b] *"Increased Standardization of Planning,"* The Wall Street Journal *(23 February 1988): p. 1.*

[c] *B. N. Sokolov, first deputy chairman of Gosstandart, says, "Clearly the risk here must be measured against the forecast losses that particular design changes may entail."*

More Standardized Planning. As noted in the inset, preparing for production during the product design stage may result in costly additional retooling because mistakes early in the product design process will be transmitted directly into the production process. Thus, product design corrections require parallel changes in made-to-order assembly lines. Gorbachev hopes to reduce these risks through increased standardization of product, process, and renovation design—a measure used in the defense industrial sector. Institutes such as The State Planning, Technological, and Experimental Institute for the Organization of the Machine Tool Building Industry were set up and tasked specifically to plan the "comprehensive retooling" [8] of existing machine-building enterprises using standards, normatives, and rules for construction (SNiPS) for organizing renovation. Modularization, standardization, and group technologies [9] are to be used for both

[8] "Retooling" in strict Western usage usually refers to the extensive replacement of the tooling—fixtures, templates, dies, and jigs—used with machine tools but does not refer to the replacement of the machine tools themselves. "Comprehensive renovation" catches the intent of this task more accurately than does "comprehensive retooling."

[9] "Group technologies" is a manufacturing philosophy that identifies and exploits the underlying sameness of the shape and size of manufactured items and of the processes used for manufacturing. See John Grayson, "Innovation at the Soviet Plant Level: The Case of Group Technology (1950-70)" in *Industrial Innovation in the Soviet Union*, ed. Ronald Amann and Julian Cooper (London: Yale Press, 1982), pp. 101-126.

new types of capital equipment and construction materials. (After the new, tighter standards took effect on 1 January 1988, chemical machine builders, at least, were unable to manufacture certain special-order equipment because it did not conform to grouped drawings.)

Meanwhile, a March 1986 Council of Ministers decree obligated Gosstandart and the machine-building ministries to simplify the procedure for developing technical documentation for new machine-building output. In the same vein, the Soviets pushed standardization of documentation for product changes—which is especially important as all documentation work must be repeated every time there is a change in the product line.

Enhancing Dissemination of Information. Because Soviet factories (vice ministries) are to make more of the decisions about when and how to renovate, Gorbachev has taken steps to spread knowledge of new technologies for renovation in order to improve the quality of decisions made by the average factory. First, he has increased the publicity given to the technological successes of individual enterprises—an approach in keeping with the Soviet tradition of touting leading enterprises as examples to be followed. The director of the Ivanovo Production Association claims that 15 of the country's enterprises are using Ivanovo designs. Indeed, when the Gor'kiy Automobile Plant decided to modernize its truck production lines, it decided to first create a subsidiary automated production facility for specialized truck manufacturing equipment based on proven designs and documentation from the Ivanovo Machine Tool Plant.

Gorbachev has also strengthened Soviet–East European enterprise-to-enterprise ties as a means of spreading technical information and expertise. One example of this is the Czechoslovak-Soviet joint research and production association "Robot" founded in 1985. Robot is now working on a plan to renovate the series production of machine tools at Moscow's Krasnyy Proletariy factory.

At the same time, the Soviets have put out several feelers to involve Western businessmen in joint ventures—authorized contractual partnerships between Soviet and Western firms for the production of goods on Soviet territory—which would require the renovation of existing enterprises. This is a break from past practices. Formerly the Soviets purchased Western machinery primarily for reequipment, or occasionally as part of major turnkey projects. 25X1 25X1

Double-Shifting Campaign. Gorbachev has made double-shifting, which began in 1986 as a Leningrad-based campaign, a national priority—especially for machine builders. This program calls for transferring workers on day shifts to evenings and nights to use their enterprise's most advanced production lines to full capacity. The now-surplus older lines are to be scrapped, and the space freed by their removal is to be used for even more advanced equipment, thereby holding down the need for new industrial construction and freeing resources for other uses. Moscow also probably hoped that the move to double shifts would pay for itself. While workers were to be paid more for shift work, they were also supposed to be more productive using the newer equipment. 25X1 25X1

Gorbachev put tremendous pressure on the party, government, and ministries to implement double-shifting. In Moscow alone 652 enterprises went to double shifts in the first three quarters of 1987. The cities, however, had trouble squeezing additional services (transport, child care, public dining) from already strained infrastructures to support fully the double-shifting campaign. Thus, in spite of the pay differentials mandated by the decree on shift work, the morale of workers assigned to the evening and night shifts sagged, absenteeism and job turnover increased, and productivity suffered (see figure 6). Meanwhile, enterprises found it difficult to meet their increased payrolls using only their own resources. Although they asked for increased assistance, the leadership generally has only called upon cities and enterprises to introduce double-shifting in a better and more vigorous manner without telling them how or giving them additional resources. As a result, the number of workers on second and third shifts was only 2.5 percent higher in 1987 than in 1986. 25X1 25X1 25X1

Figure 6. (Upper) Many enterprises turned out to be unprepared for the transfer to two- and three-shift work.
(Radio) We begin this transmission for those who aren't sleeping.
(Lower) I generally enjoy the third shift.

Decentralizing Reform Measures

While pursuing new administrative measures to promote reconstruction, Gorbachev has introduced an incomplete but major decentralizing reform program to improve overall economic performance. Two elements of this reform—self-financing and the reconfiguration of foreign trade—directly affect enterprise financial incentives to renovate.

Self-Financing. As of 1 January 1988, all civilian machine-building enterprises were moved to self-financing, and each is now expected as a matter of course to finance all of its current and capital expenditures (including renovation) from its sales revenues and other internally generated funds—a condition labeled "full economic accountability and self-finance." Gorbachev hopes that, having earned the money themselves, enterprises will spend it carefully and effectively. 25X1

Under self-financing, enterprises should have more automony because most renovation is to be financed from the production development fund (PDF), the size of which depends on amortization deductions, an enterprise's current profits, and the share of those profits that is to go into the production development fund. But Moscow still determines how much money can be spent on renovation because it controls the share of enterprise profits that is placed in the PDF and retains the right to reallocate investment funds from renovation to, for example, housing by changing the relative shares of profit placed in the PDF and an enterprise's housing fund. 25X1

Further, financial shortfalls are often caused directly by Moscow, because a plant's profitability is determined by the state-set price of its primary products. Some 13 percent of all industrial enterprises now fail to make profits, and many others fail to make profits sufficient to fund their renovation needs. Industrial prices are not due to change until 1990, so enterprises cannot raise prices to cover costs. In a market economy, factories would halt production if prices could not be raised, but in the Soviet system neither option is available. Such financial shortfalls obviously disrupt retooling plans and postpone modernization. 25X1 25X1

The existence of enterprises that are operating at a loss leads directly to another serious problem—the tendency of ministries to use their profitable enterprises as "cash cows." Ministries with large numbers of unprofitable enterprises tend to increase the share of profits remitted by profitable enterprises to the ministry—eroding the incentives for enterprises to earn profits (see figure 7). One of the more radical reform economists complained that ministries fixed the shares of these remittances at 92 to 94 percent of total profit. It's no wonder that Abel Aganbegyan claims that this flexible allocation of profits can "stifle anyone." 25X1 25X1

Figure 7 This cartoon depicts a ministry taking from the thrifty factory to give to the profligate factory.

In late 1987 and early 1988, Moscow temporarily bailed machine builders out of almost 4 billion rubles of debt by combining a one-time debt forgiveness program with a package of bank loans. However, machine-building officials fear that when these loans come due later this year, half their enterprises will not have enough money to pay wages, much less to repay the loans. Thus far, the new financial pressures that the leadership had hoped would motivate machine builders to produce more, retool, and conserve resources have more often led to increased demands for monetary relief that are likely to intensify, at least until scheduled revisions in industrial prices take effect in 1990.

Despite all of these problems, self-financing has already provided positive results—in some cases it motivates enterprises to choose new capital equipment more carefully. The same enterprise director who previously was overjoyed when he received equipment he had not ordered now claims that under self-financing he must "look at every price 10 times" to make sure he is not paying too much.

Direct Foreign Trade. The other reform program affecting renovation is the reconfiguration of foreign trade. In January 1987 Gorbachev expanded the foreign trade rights of all civilian machine-building ministries and selected machine-building enterprises. They are now permitted to keep the bulk of the hard currency profits that they earn through exports and are supposed to spend their retained profits "primarily on the import of machinery, equipment, and materials for the needs of retooling and modernization."

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To date, the impact of changes in the foreign trade area on factory modernization has been mixed. Moscow still indirectly controls how much hard currency an enterprise can earn by tasking factory capacity through annual plans. Further, it is not clear whether enterprises with foreign exchange rights will use them to renovate—as intended by the reform initiative—or instead will use them to support current production.

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Absorbing the New Measures Into the Economic System

The administrative measures intended to support Gorbachev's factory renovation program could be balanced against their decentralizing counterparts if these were the only determinants of Soviet enterprise behavior. Certainly accelerated preparation for production can coexist with self-financing. But Gorbachev's renovation initiatives, to be effective, ultimately must find their niche within the overall schema of the Soviet economy. Leonid Abalkin, Director of the

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Administrative Measures Versus Decentralizing Reform

The preeminence of administrative, or directive, measures over decentralizing measures or market forces has been the hallmark of the Soviet centrally planned economy to the present and will remain so at least through 1990. Traditionally, Soviet central economic planners set output targets, determine input levels, and allocate investment. While outputs, inputs, and investment goods have prices, these prices are also determined by the center and are changed only infrequently. Prices do not change in response to changes in the supply or demand of goods, so prices do not serve to reallocate resources among alternative uses. Prices in this system exist primarily for accounting purposes. Resources are reallocated only when the center determines that there is a substantial imbalance between supply and demand, and gaining the center's attention sometimes requires an imbalance of crisis proportions. If the central planners decide to act, resources are taken from lower priority economic sectors and transferred to higher priority sectors.

Prices play a much greater role in a market, or decentralized economy. When shortages occur, firms initially bid prices of a good in short supply up, and the good is reallocated from those firms for which it is less important to those firms for which it is more important. Next, the good's new, higher price sends a signal to current or potential producers of the good to produce more. They, in turn, reallocate their resources and produce more of this good and cut back on the production of other goods. The supply of the original good expands, its price falls, the supply of all other goods is reduced, and their prices rise.

The investment strategy of a firm operating in a market is most influenced by prospective profits—which depend both on a firm's current and projected profitability and interest rates. Market firms that invest face the same choices—reequipping, reconstruction, expansion, or new construction—faced by Soviet enterprises. Reequipping takes less time, can be somewhat disruptive (and reduce current profits), and provides limited payoffs. Reconstruction is more disruptive, takes an intermediate amount of time, but can provide substantial eventual returns. Expansion does not disrupt current operations but costs more and can take longer. Any of these options, or none, could be best for a particular firm at a given moment, depending on its individual situation and interest rates.

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Gorbachev's proposed changes to the Soviet economic mechanism will create only the facade of a market, especially through this FYP and probably into the next. The center will still set prices, and enterprises will not be completely free to produce as many goods as they wish at those prices. What is likely to happen is that enterprises, to the extent possible, will produce those items on which they can make a profit and discontinue production of unprofitable items. However, because prices of primary and intermediate goods are also fixed, the market mechanism that reallocates production resources from one primary good to another is short-circuited, and the producers of profitable goods are likely to face shortages of primary and intermediate inputs. Soviet enterprises are likely to face similar problems with renovation in a mixed environment. Enterprises are likely to find particular equipment items are unobtainable, and they will not have the legal authority to raise their offer price.

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Economics Institute of the USSR Academy of Sciences, a five-year plan is implemented either on a traditional, administrative basis or on a "reformed" basis; plans cannot be implemented on a mixed basis. According to Abalkin, the 1986-90 FYP is being implemented on an administrative basis (see inset). While Gorbachev has put a few decentralizing, "reform" measures in place, they are not yet fully operational in the sense that they are the primary determinants of enterprise renovation strategies. Their impact is muted in large part because centralized administrative planning is still the Soviet norm, and meeting administratively determined, short-term output goals continues to be far more important to an enterprise manager's career than implementing renovation.

Because the vast majority of industrial activity continues to be driven by the traditional incentive system, Gorbachev has to depend on redundant and overlapping directives to guide renovation decisions to meet FYP goals. These vestiges of the command economy—especially directed investment and state orders—will affect renovation decisions far more than will the incentives provided by Gorbachev's reforms.

Directed Investment Quotas. The 1986-90 plan allocates capital investments among ministries, departments, union republics, and branches of the economy and specifies investment targets for the renovation and retooling of existing enterprises. A typical enterprise that wishes to retool during the remaining years of this FYP will be able to do so only if it has a plan quota for renovation outlays, can acquire producer durables through the Gossnab system, and has an authorized construction quota. However, capital investments for enterprises were distributed and approved before the enterprises converted to self-financing. Consequently, the capital investment quotas were not coordinated with the planned sources of financing—the enterprise's production development and amortization funds. Some enterprises will have more than enough to finance renovation projects from their own funds; others will have to borrow from their ministry or the USSR Construction Bank. However,

Curbs on Free Spending of Plant Profits

"The existing practice of defining the state order . . . makes it practically impossible to find an outlet for the additional profits. What can you purchase at your discretion when the output of many enterprises and whole sectors whose goods are of particular interest to the consumer is 'swallowed by the state order'?

"What can the Volga Truck Plant acquire with the 130 million rubles in above-plan profit that it gained last year? Buy a machine tool, for instance, from Frezer? But all Frezer's output apart from packaging and swarf [metal shavings] goes toward the state order. . . . In its turn Frezer or another enterprise 'with revenue' may want to buy a bus, but practically all the vehicles produced by the Ministry of the Automotive Industry are incorporated in the state order."

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rearranging the capital investment allocations and construction quotas will be much more difficult than borrowing funds.[10]

State Orders. State orders (*goszakazy*) are plan orders for the most important types of goods—fuel, energy, some consumer goods, and most producer durables—that are placed by either Gosplan or the ministries. State orders are a vestige of centralized control of industrial production during the economic transition period and protect critical programs such as weapons production. However, the current high share of state orders in total machinery output severely limits the ability of machine-building enterprises to undertake

[10] In the opinion of informed Soviet economists, the main function of production development funds for many enterprises during 1988-90 will be to provide Gosplan information so that it can more accurately match capital investment quotas with projected sources of enterprise investment finance in the 1991-95 FYP.

renovation. For example, state orders account for 86 percent of the 1988 production program for the Ministry of the Machine Tool and Tool Building Industry, and state orders for many machine-building enterprises in Moscow "account in full for the entire production program and at times are even in excess of production capacity." These high levels of state orders relative to capacity have led many to complain.

These high levels of state orders slow machine-building's modernization in four ways:

- Tasking at or near full capacity makes it impossible for an enterprise to shut down production and undertake major reconstruction.
- As is the case at the Moscow Ball Bearing Plant, state orders can be placed for the least profitable items, which reduces profits and, in turn, the size of the enterprise's production development fund.
- The prevalence of state orders makes large PDFs nearly irrelevant because there are few producer durables available for purchase outside the state orders system (see inset).
- Even when the state orders themselves are for technologically advanced machines, the additional planning required for state orders can slow the diffusion process.[11]

Disappointing Preliminary Results

Because so little has changed with respect to where the decisions are made and the incentives affecting these decisions, Soviet performance in machine-building plant renovation during Gorbachev's first years largely continues to reflect the weaknesses inherent in centrally administered renovation:

- In June 1987 70 percent of renovation investment provided "zero" return because it was merely reconstruction for the sake of reconstruction.
- By the third quarter of 1987, in Leningrad, 60 percent of rehabilitated plants surveyed had unspecified problems reaching planned production levels.
- In Leningrad, many machine-building ministries have put off renovation plans until 1990 after sharply slowing the growth of investment dedicated to renovation in 1987.
- Most recently, in February 1988, three Soviet economists admitted in a *Planovoye khozyaystvo* article that the renovation of machine building "is in a state of serious disruption."

Nor is Moscow having much success in concentrating equipment and construction resources on the most important projects. Reconstruction's higher priority has not yet always paid off in practice. In 1986 and 1987, Soviet machine builders delivered only 33 to 50 percent of the requested amounts of basic types of machine tools—lathes, polishing machines, and tooth-cutting machines—ordered for reequipment and reconstruction projects. While the Soviets claim the number of projects under construction was reduced by 11 percent in 1987, the average construction time was shortened by 6 percent and still exceeds their guidelines by 260 percent.[12] For all of machine building, the gap between resources invested and resources commissioned (available to use for production) remains substantial (see figure 8).

Factory Modernization in the Remainder of the 1986-90 FYP

As long as machine-building ministries and enterprises are held to their taut five-year and annual plans, they cannot shut down plants for reconstruction. Reequipping and expansion will continue to account for the greatest share of resources spent on enterprise modernization, and accelerated technological preparation for production will be implemented only in the context of enterprise expansion. Most improvements in planning, standardization, and information flow are likely to lead to more effective reequipping rather than more reconstruction. While increased and better reequipping will provide a larger and more modern production base than exists now, it will not provide the gains that Gorbachev had hoped would come from reconstruction, nor will it provide

[11] Stepan Shalayev, head of the Central Council of Trade Unions, complained at the October 1987 Supreme Soviet session that of 160 new machinery items developed by intersectoral science and technology complexes, only 78 were included in the state order of the draft 1988 plan.

[12] See Ye. T. Gaydar, "Improvements Course, Economic Review," *Moscow Kommunist*, No. 1 (January 1988): pp. 41-50.

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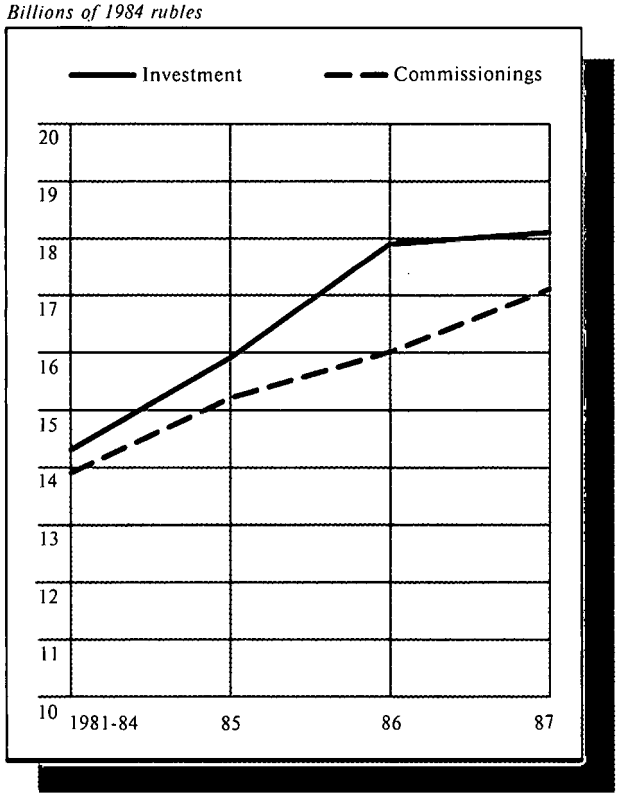
Figure 8
Growth of Capital Investment and Capital Commissionings in Soviet Machine Building



the modernized base that Gorbachev expected to characterize Soviet machine building at the end of the economic reform transition period.

The contradictions between administrative measures and fledgling enterprise financial autonomy are likely to delay factory modernization:

- State orders—backed by force of law—will continue to be placed for unprofitable, obsolete, low-quality items. Such orders often conflict with other state-imposed requirements and can result in low profits and fines for producing obsolete or low-quality goods, which in turn draw down the production development funds of producing enterprises. Ministries often react to these perceived inequities by reallocating PDFs from one enterprise to another, further reducing the incentive to earn profits.

- Self-financing also threatens fulfillment of Gorbachev's renovation goals because the enterprises may become more reluctant to spend their hard-earned rubles. In early 1988, one Siberian enterprise refused to upgrade its prototype assembly lines because under the new financial arrangements the upgrade would be at the expense of workers' profits. While the enterprise had some money, and acknowledged the upgrading project had merit, it also felt that it should be financed from its ministry's own centralized resources because the ministry wanted to develop the lines for use at other enterprises within the ministry.

- Further, the wider range of choice envisioned under self-financing is likely to be undercut by the standardization drive. Since technology evolves in often unpredictable ways not subject to guidelines and specifications, Moscow's attempts to administer tightly the supply side of the product development process are likely to impede, rather than reinforce, an enterprise's freedom under self-financing to acquire technically advanced, yet exotic, equipment.

- The edict on accelerated technological preparation for production seems to lack an effective enforcement mechanism and is likely to be ignored as long as machine builders are dominated by state orders. Also, though machine builders are now self-financing, the economic reforms have not reduced the influence of the State Committee for Prices. As long as enterprises face arbitrary and often retroactive price rollbacks on successful new products, they have only weak financial incentives to put new models into production under any circumstances—much less to halt current production and undertake major reconstruction. Indeed, some Soviet economists fear that self-financing provides enterprises significant opportunities to expand or start new construction projects—leading to even greater dissipation of construction resources than now exists. This is the very problem Moscow was trying to correct with increased project review.

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Fundamentally, Soviet enterprise managers still correctly perceive that if they fail to fulfill the current year's plan and promise to fulfill next year's plan (after renovation) they are far worse off than they

would be if they meet this year's plan and promise to renovate next year.[13] At least until 1991 an enterprise will be taking a high risk in stopping production to reconstruct his factory.

Many problems in determining whether an enterprise's best modernization choice is to reequip, reconstruct, expand, or build anew arise because Soviet-administered prices fail to transmit accurate information—they do not reflect actual resource scarcities. Choices based on administered prices often turn sour, and the overall costs of modernizing the economy increase. However, even though the present system inhibits choosing the most efficient path to modernization, Gorbachev can implement policies to increase the amount of modernization—though each option has an attendent cost.[14]

Prospects and Leadership Options

Gorbachev's current and proposed initiatives should result in real but slow progress in factory modernization. The return on his program will be limited primarily by the fact that not one of the policies he has introduced provides much incentive for enterprises to reduce current production for the sake of future growth. Enterprises will continue to choose reequipping as a means to meet centrally imposed renovation goals and will avoid disruptive reconstruction. Factory modernization—as it is likely to be implemented—will not yield the technological basis for rapid economic growth:

- Expansion and new construction will remain the types of factory modernization that enterprises prefer. These are construction-intensive forms of investment, however, and will compete with the high-priority housing program for limited construction resources.

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- Significant technological boosts from better product design are unlikely because the standardized, bureaucratic system of product design has, if anything, become more rigid.

- Extensive and effective reconstruction will occur infrequently, usually only at selected enterprises when Moscow brings intense pressure to bear.

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If Gorbachev decides that factory modernization should have a higher priority, he can take several steps that would give a one-time boost to the pace of factory modernization:

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- He could scale back his announced plans to build more housing. This would free construction resources, permit modernization to take place through expansion and new construction of factories, and would not interfere with production at existing factories. This option is unlikely given Gorbachev's highly publicized commitment to increasing the amount of housing.

- He could reduce planned investment in other investment-intensive sectors of the economy, such as agriculture and energy. While this would free some resources, it would not free the right type of resources. Modernization can be boosted either by transferring high-quality material inputs or construction resources. Construction comprises a small share of energy investment, and agriculture cannot provide high-quality material inputs. In addition, significant investment transfers would threaten the food and energy program goals.

- He could reduce machine building's planned output goals. For an individual factory, cutting the output plan for a year or two provides the breathing room needed for reconstruction. In the aggregate, however, cuts in machine building risk chaos because one factory's production becomes the next factory's new assembly line. But, if the plans are carefully crafted,

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[13] Soviet Professor of Economics V. Kirichenko, in the December 1987 issue of *Planovoye khozyaystvo*, discusses the 1988 plan and notes, "The new principle that is being put into effect is: if you failed to meet the plan in the current year, work more intensively in the coming year, make up for lost time, meet the five-year plan targets. This is specifically the position that will confront many machine-building enterprises in 1988."

[14] The nature of the above conflicts should change somewhat with the further extension of reforms and adjustments to the price system scheduled in 1990 and beyond. However, the analysis of the potential for conflicts between factory renovation initiatives and the next round of reforms is quite speculative and so is addressed in the appendix.

implemented at the start of the next five-year plan period (1991), and combined with imports of machinery and equipment sufficient to offset domestic production shortfalls, this policy offers a way of breaking out of a technological rut. The risk of this option is that with either poor planning or bad luck the Soviet Union could find that it had replicated the Polish experience of the 1970s—piling up a huge foreign debt to create new factories that are technologically backward. The risk is probably too great for Gorbachev to implement this option throughout machine building, but his public statements hint that he may consider it for factories building textile or food-processing equipment.

- He could reduce defense spending. If defense's claim on resources were reduced substantially, the reduced tautness in the economy generally and the greater availability of high-quality resources would permit more and better equipment designs to proceed from the drawing board to series production. As a result, the effectiveness of technical reequipping could be increased. Reconstruction would also be possible at civil factories whose quotas could be cut because production of intermediate goods for defense was no longer required. Gorbachev's public statements indicate some sympathy for this option.

While each option would provide a one-time boost to factory modernization, none of these centralized, administrative actions would create the groundwork for an improvement in the factory modernization process. In the absence of systemic change and relaxation of taut planning targets, Gorbachev's program is likely to provide only modest improvements. The use of reconstruction as a common method of modernization is unlikely until Moscow's power to administer factory output and technological design is reduced. Until then, most factory renovation will continue to take the form of reequipping, and new machinery models will be only incrementally better than those they replace. Thus, Gorbachev's attempt to modernize the civil machine-building production base—while making some progress—is not likely to provide the hoped-for gains in efficiency, improved product quality, and production levels, nor will it result in the modernized technological base planned for civil machine building by 1990. As a result, we believe broader industrial modernization—a process dependent on the availability of more and better machinery and equipment—will fall far short of plan.

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Appendix

Factory Modernization in a "Restructured" Economy

The investment process during the 1991-95 FYP is to be based on a "reformed" system, but factory modernization in the 1990s will be shaped by both administrative and reform measures. Reformers want financial incentives to be the primary guides to enterprise renovation decisions, with the expectation that financial incentives will be so structured that enterprises will voluntarily seek out optimal technologies, accelerate the preparation-for-production process, and choose double or triple shifts without the club of administrative compulsion.

The "Ideal" Investment Decision Making Process

In a "reformed" economic system, Soviet enterprises, in theory, will behave as would Western firms faced with the challenge of modernization. Soviet enterprises will maximize profits, for the good of the collective and the locality, based on new, rational prices (circa 1990) and subject to constraints imposed by Gosplan and the ministries. Thus, if an enterprise sees the need to renovate early in the five-year planning period, it will slow production, modernize its assembly lines, and make up for below-target output early in the period with above-target output late in the period. Alternatively, if an enterprise produces above plan targets early in the period, it can accumulate money in its PDF, secure in the knowledge that targets will not be raised, that its PDF will not be reallocated, and that it can shut down and modernize late in the plan period. Because enterprises will be under pressure to maximize a *stream* of profits, they will voluntarily risk accelerated preparation for production, just as Western firms have done.

Also in theory, modernization will be planned on the basis of the best available technology—Western, East European, or domestic. Gorbachev plans to increase the availability of domestic equipment by revamping the unresponsive centralized Soviet wholesale trade and distribution system. Free wholesale trade in the means of production—producer durables—is scheduled by 1992. Enterprises will be able to purchase equipment best suited for their particular renovation needs on the basis of direct negotiations with suppliers. Purchases abroad will be made using the firms' own export earnings. The ministries, Gosplan, Gosstroy, and the GKNT, however, will continue to share overall responsibility for guiding the technological modernization of enterprises. Increased standardization of products, processes, and project development will permit them to conduct their oversight responsibilities in a more timely and accurate fashion. 25X1

Factory Modernization in Practice—Difficult Choices 25X1

But before the Soviet modernization program of the 1990s can proceed as hoped, the Soviet leadership must decide between wider adoption of decentralized incentives and continued reliance on administered controls. Moscow's challenge will be to set financial incentives that ensure the proper level and quality of investment and the right mix of reconstruction. The Soviet leadership's desire to have factory modernization guided more by financial levers and less (but still influenced) by administrative levers could be thwarted unless leadership preferences are consistent and prices accurately reflect these preferences. To do so, the planners and the leadership will have to devise and agree on a price mechanism that features sufficient competition and flexibility to assure that:

- Enterprises make the "right" choice between current output and modernization for future production.
- Enterprises have the incentives to develop and disseminate new technologies. 25X1
- Enterprises that attempt to produce new products are able to bid for essential high-quality raw materials and intermediate inputs—priority goods that traditionally have been administratively allocated to the defense sector. 25X1

Between Current Production and Modernization. In a market economy, the balance between current production and modernization is struck as millions of firms and individuals evaluate their own unique investment options with regard to product and input prices and current interest rates. After the next round of reforms, the Soviet leadership intends to set the aggregate volume of investment and to allocate much investment directly from Moscow, letting financial incentives guide remaining investment decisions. Moscow faces the challenge of inducing tens of thousands of enterprises to undertake actions that mesh with central goals. The leadership will probably find that financial incentives are unwieldy and erratic instruments of compulsion. For example, to encourage machine builders to produce more requires high producer prices for capital goods. However, as prices of producer durables rise, enterprises become more reluctant to retool. If the Soviet leadership nevertheless forces the pace of factory modernization in the face of rigid prices for producer durables, it may be forced to provide enormous subsidies for reconstruction.

Price manipulation to encourage reconstruction rather than reequipping or expansion will also cause difficulties. Decentralization, combined with the expected "high" control figures for output targets, will continue the current incentives for enterprises to expand rather than undertake reconstruction. While these incentives can be offset by raising the prices of construction materials, this action is inconsistent with Gorbachev's housing construction (and cost containment) goals, and attainment of both objectives would require differentiated prices for builders of houses and builders of factories. If prices are not differentiated, excessively high prices will encourage reequipment at the expense of reconstruction, but prices that are too low will cause too much factory expansion (vis-a-vis housing) or a shortage of construction materials.

Thus, while enterprises will be encouraged to respond to price incentives, their actions will frequently be at odds with central goals. Moscow implicitly acknowledges this dilemma and is prepared to override incompatible responses to price incentives with another mechanism of central control. The Gosplan decree directs Gosplan to determine "overall volumes of contract construction work as the basis for the conclusion of contracts by construction organizations." In effect, the central planners will continue to set individual investment and renovation quotas for each enterprise—the current procedure—and this will override many of the incentives of self-financing and PDFs. 25X1

Between Standardization and the Diffusion of New Technologies. Prices also affect the diffusion of new technology. In a market economy, firms have the choice of either developing or using new technologies. Relative freedom of entry, even with patents, means that alternative technologies can be developed to solve particular production problems, and prices of new classes of advanced equipment, such as computers, tend to fall as new suppliers enter the business. The central administration of technology reduces the freedom to develop and produce products incorporating new technologies. 25X1

Moscow plans to change prices of producer durables by 1990 to reflect changes in resource costs that have occurred since the last major price revision in 1982. Because technology is also an input of new equipment models, its cost should be incorporated in the price of new equipment. Moscow, however, finds it difficult to measure either the costs or benefits of new technology with any accuracy, so setting correct prices for new equipment is difficult. The diffusion of new technologies is also hindered by the absence of financial incentives encouraging innovating enterprises to share information on indigenously developed technologies. For example, the director of the Ivanovo Machine Tool Production Association wants the rules changed so that his plant will receive 5-percent royalties on every process it develops. Others, mostly inventors, argue that payments should go to the individual inventor rather than the sponsoring plant. Without incentives, both enterprises and their employees are uncooperative about sharing expertise and technological dissemination is delayed. 25X1 25X1 25X1

In spite of these drawbacks, Moscow intends to maintain the preeminence of administrative measures in technology policy. Gosstroy, the GKNT, Gosstandart, the ministries, and the Machine Building Bureau will continue to share responsibility for setting technological standards and disseminating technologies. Although central administrative control of technological policy and prices generally distorts incentives and hinders technological progress, it provides some benefits, especially if monopolies are widespread. Administered technology—along with centralized prices and mandatory plans—can counteract the tendency of monopoly suppliers of equipment to provide limited quantities of low-tech equipment at high-tech prices. One result of decades of Soviet campaigns for specialization is that many important types of producer durables are produced at only one or two enterprises. As Ryzhkov said, "monopolism is literally suffocating us." Without competition in the manufacture of, for example, food-processing equipment, the elimination of centralized technology policy risks the fulfillment of Moscow's high-priority plan to rapidly modernize the food-processing industry. Thus Moscow will be tempted to centrally administer technology until sufficient competition develops among machinery suppliers to provide incentives to build advanced equipment.

Between Guns and Butter. Because the USSR's huge defense sector cannot be isolated from the rest of the economy, continuing to ensure defense's priority claim on resources by administrative means will put added pressure on markets. In particular, defense's claim on industrial resources is so large that the Soviet leadership will have to perform a delicate balancing act to keep profits from state orders from becoming either too large or too small, and thus hindering the relative development of either the enterprises engaged primarily in civil production or the enterprises that specialize in state orders. For example, those civil plants that make components for defense are likely to receive state orders to do so—at prices set by the state. Many enterprises that are forced to take such orders are likely to make below-average profits—limiting their ability to finance modernization or provide worker amenities. 25X1

The priority given to defense also creates distortions in product design. In an economy of pervasive shortages, designers of civil machinery will still be forced to design products around actual material availability rather than designing products to meet theoretically better but practically unreachable specifications. For example, Soviet locomotives are now designed around the limitations of low-grade steel—the only steel generally available with which to build locomotives. The use of lower quality steel also has hindered Soviet efforts to adapt US technology to Soviet combines.

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stainless steel constitutes only 30 percent of the materials used to construct Soviet machinery for food processing, whereas the proportion is about 60 percent in the West. 25X1 25X1