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January 1975

SOVIET INTRODUCTION OF NEW TECHNOLOGY: A DEPICTION OF THE PROCESS

By: DAVID GRANICK (Consultant)

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Prepared for:

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
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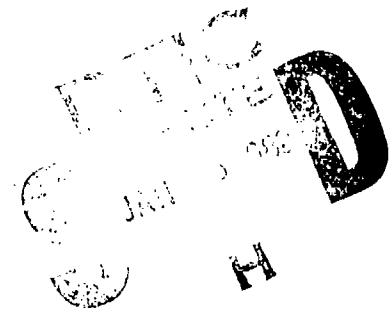

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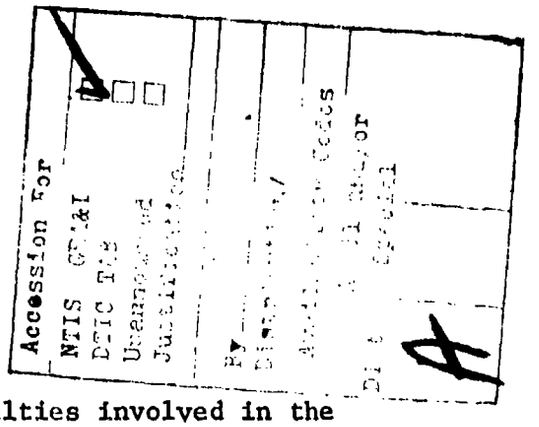

ABSTRACT

This paper presents a discussion of the difficulties involved in the introduction of new technology into civilian industry in the Soviet Union. It explains those problems which are found particularly in the Soviet planned economy as opposed to private enterprises in developed capitalist countries. The report concentrates on the issues of incentives, but also deals with the problem of transferring new technology from the laboratory to the production line, the difficulty of acquiring new information about new technology developed abroad, and the degree to which research, development and production should be carried out within distinct organizations. Through the use of a qualitative model, the forces at work within the USSR, especially at the level of the production enterprise, are depicted and are contrasted to a different model describing the same forces in the German Democratic Republic. One critical feature--managerial philosophy--is singled out as differentiating the two models and application to the USSR of the East German concept is discussed.

DISCLAIMER

The views and conclusions contained in this report are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the Defense Advanced Research Projects Agency of the U.S. Government.

CONTRACTUAL TASK

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FOREWORD

One of the major problems faced by the Soviet Union in maintaining an acceptable growth rate of its economy is the introduction and assimilation of new technology into civilian industry. This is due to a variety of reasons including an insufficiency of the system of incentives, difficulty in transferring new technology from the laboratory to the market, access to foreign markets, and organizational problems. The German Democratic Republic, another centralized socialist country, has had fewer problems in this area, and the study indicates that managerial philosophy is a critical feature differentiating the two systems. This is a feature which could be adopted by the Soviets without violating their socio-political beliefs.

This study is a subtask of SRI/SSC's National Security Policy Research Project 2625. As such, it fits into the overall DARPA program on U.S./USSR technology exchange. It has been undertaken under SSC's Soviet and Comparative Economics Program headed by M. Mark Earle, Jr., Senior Economist and Assistant Director, and Herbert S. Levine, Senior Research Consultant. The thoughtful and detailed comments of a number of reviewers are gratefully acknowledged, with special indebtedness to Murray Feshbach, Louvan E. Nolting, and Laurie Kurzweg of the Department of Commerce. The report is a contribution to the efforts of the U.S. Government to increase our understanding of the implications of U.S. technology transfer and Soviet technical change for Soviet economic development.

Richard B. Foster
Director
Strategic Studies Center

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I INTRODUCTION

This report discusses the problems involved in the introduction of new technology into civilian industry in the Soviet Union. The purpose is to explain those difficulties in the process which are peculiar to the Soviet planned economy in contrast to private enterprises in developed capitalist countries.

For this purpose, the main concentration of the report is on the question of incentives. A qualitative model is constructed to depict the forces at work in the USSR (particularly at the level of the production enterprise). A different model is then presented to describe the same forces operating in the German Democratic Republic--another centralized socialist country--and the effectiveness (for the assimilation of new technology into production) of the two models is contrasted. A single critical feature (managerial philosophy) is singled out as differentiating the two models--a feature which Soviet leaders could adopt without violating their sociopolitical beliefs.

Modeling in this report will be restricted to the basic problem of incentives. But three other problems will be discussed first:

- The existence of disproportions among the necessary elements in the chain leading from basic research to the process of implementation in the form of new products or processes.
- The difficulty of procuring desired information as to new technology which has been developing abroad.
- The organizational issue of the degree to which research, development and production should be carried out within distinct organizations.

The above three issues are common to the process of absorption of new technology anywhere in the world. But in all three areas, just as in that of incentives, the USSR faces peculiar problems which warrant discussion.

II EXISTENCE AND NATURE OF THE PROBLEM

A. Existence of a Problem

All countries find the process of implementing new technological developments to be difficult and painful. The West European complaints of the second half of the 1960s as to the existence of a "technological gap" vis-a-vis the United States were centered on the problems of absorption of new technology. The British literature in particular was filled with statements of British successes in early industrial research, followed by failure in transforming such research into marketable products. Is there anything peculiar about the dimensions of the Soviet problem?

This is a major question, and one which cannot be seriously investigated in this report. The assumption will be made that Soviet difficulties are unusually great in this regard. Patchy evidence will be presented to support this view, but it still must be taken as no more than an assumption. It is, however, an assumption which appears to be universally made (although often only implicitly) by both Soviet and Western investigators.

The evidence for it is the technological backwardness of the USSR compared to Western developed countries: such backwardness consists both in the methods of production used (essentially, relative shares of different types of equipment in the production process) and in the relative shares of "modern" products in the product mix of individual industries. On the basis of such evidence, Amann, Berry and Davies concluded in 1969 "that the Soviet Union is less technically advanced than the United States in all but a few priority industries, and that in a number of major industries the Soviet Union is technologically behind the industrialized countries of Western Europe."[1] *

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* For serially numbered footnotes, see Appendix A; for a list of books cited, see Appendix B.

This can be seen in a wide variety of industries. In the machine-building industry, for example, Russian writers have long recognized that much too little forging-pressing equipment is used in relation to metal-cutting equipment; yet as of 1970, no change had occurred in this proportion for many years.[2] In 1960 the USSR was unusual internationally with regard to the high proportion of its total pig-iron production which was used for iron castings. During the following ten years, this proportion fell by 29 percent; but of the three capitalist countries which had also had high proportions in 1960, two showed rates of decline in usage which were twice as fast as that of the USSR. While in 1960 the USSR ratio was 22 percent higher than that of the next worst country (the United Kingdom), in 1969-70 it was 36 percent higher than the next worst (Italy).[3] About 1970, the Soviet Union was said to be using 50 percent more iron and steel per unit of industrial product than was the United States; the explanations given by two Soviet experts were the poor quality and narrow product range of Soviet steels, inadequate production processes in the machine-building industry, and obsolete designs of many machine products.[4] At the end of 1970, only 0.2 of 1 percent of all metalcutting machine tools used in the machinebuilding and metalworking industries had programmed drive.[5]

In the textile industry, the USSR seems to have done peculiarly poorly in keeping up with the revolution which has been occurring internationally. Between 1960 and 1966, the American industry achieved an 8 percent increase in the amount of cloth woven per loom; the Soviet industry, in contrast, showed a slight decline.[6] In 1970 a Soviet writer said that much of the equipment produced domestically for the textile industry still lagged behind world levels.[7] The 1970 national plan called for only about 0.8 of 1 percent of all Soviet cloth to consist of nonwoven materials, a product whose use was rapidly developing internationally.[8]

In 1970, 27 percent of all coal produced in the USSR was stripmined, and this percentage was planned to rise to only 31 percent in 1975.[9] In underground coal mining, hydraulic mining was developed in the USSR in the 1950s, and in 1959 the government decided to introduce it widely

so that 41.6 million tons would be mined in this fashion by 1965. In fact, only 3.8 million tons were so mined in 1965, and only 9.0 million tons (1.4 percent of all coal) in 1970. The fault for this relatively slow expansion rate is said not to have lain in the technology, which worked well where it was applied.[10]

The chemical industry has been given great stress in the USSR since the late 1950s. In 1970, production of plastics and synthetic resins had grown to five times the 1960 output; yet, since this was a rapidly growing industry throughout the developed world, 1970 per capita production in the USSR was still only one-fourth to one-fifth that in Japan, France, and the United Kingdom, and one-sixth to one-seventh that in Italy, the United States, and West Germany.[11] The chemical-fiber industry grew by 176 percent between 1960 and 1969; but per capita production in Japan, West Germany, and the United States grew by almost the same percentage, and even in France and Great Britain the growth rate was half as fast. Thus there was little catching-up here either. What is most striking, however, is that only one-third of the Soviet growth in chemical fibers' tonnage during the 1960s was in synthetic fibers (polyamide, polyester, and acrylic), while two-thirds was in the traditional artificial fibers (mainly viscose and acetate). As of 1969, synthetic fibers constituted a mere 24 percent of total Soviet tonnage of chemical fibers, compared with 52 to 69 percent in each of the capitalist countries of Britain, France, Japan, West Germany, and the United States.[12] In a detailed draft-study of the chemical industry, R. Amann evaluates the industry during the 1960s as one which has been quite slow in producing modern products on a mass scale.

The case of oil drilling is particularly interesting, as this is an industry where the Soviet Union has been the world leader in developing a new type of drilling equipment: turboborers as opposed to rotary borers. As of about 1970, 80 percent of all oil drilling in the Soviet Union was done with turboborers. Turboborers are most effective in shallow drilling; yet the average depth of holes drilled in the Soviet Union increased sharply during the period of their introduction into widespread use. (The increase in depth between 1950 and 1966 was 44 percent in

production wells and 67 percent in exploratory wells.) By the late 1960s, Soviet studies showed that even in average-depth drilling, the cost per foot of drilling was 25 percent less with rotary borers than with turbo-borers. The Soviet industry had placed its money on the wrong horse, and in the process had done little to keep up with international progress in the rotary-boring method of drilling.[13]

These data suggest that, even in sectors where the Soviet Union has lagged seriously behind the standards of other leading industrial countries, where it has recognized this fact, and where it has made strenuous efforts to catch up, little has been accomplished relatively--although a good deal in absolute terms.

Yet all of these data can be taken as no more than suggestive. First, this is the case because we do not have a genuine sample of industry.[14] Second, and more important, in at least some cases "lags" may reflect differences in relative labor, capital, and natural resource availability in the Soviet Union compared to leading Western countries, or differences in the national social welfare function as it applies to alternative products. In this case, technological "lags" may be highly functional. Only a major research effort could allow us to come to grips with these two problems. On the face of things, however, the assumption of Soviet technological backwardness seems justified.

B. Nature of the Problem

The introduction of new technology takes two forms. The most important is the production of new products. The second is the improvement of methods of production, with or without new types of equipment.

Let us turn first to the question of the batch-production of new products. Here the issue is not the inability of Soviet industry to change to new products. The Russians have done reasonably well at this--although a measure of how well they have done is not available for lack of comparable data from capitalist countries. The Soviet data come essentially from the

machinebuilding industry, but it is this industry's products which are the most significant for keeping up-to-date the technology of other industries. The available information relates to products which are batch-produced (i.e., in series), rather than to special-purpose products which are tailormade for the individual industrial customer. "Batch produced", however, is taken to mean small-series as well as large; it may be no more than 10 or 15 units per year.

A general claim has been made that, during the past seven to ten years, at least half of all products produced at the beginning of the period in all of industry had been eliminated from production.[15] In machinebuilding as a whole, it is said that this occurs every five years.[16] Considerably better data are available as to changes in the production of specific types of equipment. During the three years between 1 July 1967 and 1 July 1970, an average of 11.7 percent of the number of batch-produced apparatus were replaced annually, 11.3 percent of all machine tools (not tooling), and 6.7 percent of the products of the electrical equipment industry.[17] Of the number of types and sizes of apparatus and equipment produced for the oil and chemical industry, an average of 2.7 percent were replaced annually during 1971 and 1972, and 7.9 percent of the 1970 number were added annually during these years to the product mix available from domestic output.[18] Eighteen percent of the number of models of metalcutting machine tools produced in 1966, and 14 percent of the number of forging and pressing machine models, were produced in batch-production for the first time that year.[19]

The State Committee for Prices investigated 16,000 items produced in batch-production during 1971 by various branches of machinebuilding.

The proportion of these items which had been in batch-production for less than five years was as follows:[20]

	Percent
All machinebuilding covered	
Of this:	51
Electrical machinery	34
Apparatus of all types	61
Machine tools	55
Machinery and equipment for the coal industry	57
Machinery and equipment for producing energy	57
Equipment for road and construction work	63

Thus the Soviet problem is not that of an inability to incite production organizations to incorporate new products into their production programs. As a consequence, its technology-implementation problem is not likely to yield to the use of such typically Soviet quantitative measures as planning the proportion of a firm's total output which is to consist of "new" products. The problem is a more subtle one.

One aspect of the problem is that of overenthusiasm in pushing one particular technological development at the expense of others. The turbo-borer in oil drilling (treated above) is an example of this. A second example seems to be that of developing automatic machining lines (transfer lines), a development which was given enormous favorable publicity during the 1950s and early 1960s in the technical literature. A Soviet scholar who attempted to evaluate the results found the necessary data to be in general unavailable; but his analysis of the most publicized "success story" was distinctly negative.[21]

Such failures of expectations are, of course, inevitable in technological development in any country. But the Soviet system seems peculiarly liable to them because of the development of an internationally exceptional

degree of campaign-type pressure throughout an individual industry to adopt a particular technological approach at any given moment of time. Economic considerations in decisions appear to be neglected to an unusual degree by international standards.

A global reflection of this approach is shown in data for all industry during the first half of the 1960s. The annual per shift percentage use of existing electric-motor capacity in industry was the following:

	Index (U.S.=100)
U.S. industry (1962)	100
USSR industry (1966)	50

The Soviet author's explanation is the Soviet neglect of light (and thus cheap) machinery for purposes where these would be just as satisfactory as heavier types of equipment.[22]

The second aspect of the problem of introducing new technology seems, however, to be far more important. This is the reluctance to choose for production new products (or production processes) which represent a major advance over the status quo, since these inevitably also represent a major risk of failure. Here we are confronted with the incentive problem for Soviet enterprise managers. An enterprise management can show a good record with regard to the number of new products it introduces over a period of years, and yet avoid major risk. It need only choose new products which are minor variations on its existing product line.[23] This is the problem with which we must be most concerned.

C. Issue of the Improvement of Production Processes

There is an unresolved disagreement in the Western literature as to whether Soviet problems in introduction of new products apply equally to the introduction of improved production processes. By and large, Soviet enterprise managers have nothing to gain from introducing new products into production, and have every incentive to avoid this to the degree feasible.

But is the same true with regard to technological changes intended to improve their production of existing products? I have argued elsewhere that this is not the case, since enterprise managers are under considerable pressure to show annual improvements in labor productivity, capital productivity, and costs; they are unlikely to meet these demands if they do not accept, and even initiate, technological change. The counterargument is that technological change in enterprise A usually requires prior production of new products (equipment, semifabricates, or parts) in enterprise B, and thus that the new-process problem boils down to the new-product one.[24] It is clear that the counterargument applies to some, but not all, change in technological processes; the real issue is one of degree.

In this regard, the role of imports of equipment used in Soviet industry deserves analysis. To the degree that the "enterprise B" which produces the equipment is located in a capitalist country, the new-process problem for a Soviet firm does not resolve itself into a new-product problem for another Soviet enterprise. If "enterprise B" is located in another socialist country, the relevant question is whether that country has the same new-product problem as the Soviet Union. It will be argued in Section IX that the Germany Democratic Republic does not have the same problem, and should thus be treated separately from the other members of the CMEA (Council of Mutual Economic Assistance) bloc.

Table 1 shows the considerable role that gross imports from convertible-currency countries and the G.D.R. play in supplying the needs of the Soviet Union for machinery and equipment. In 1970, 5.4 percent of all Soviet consumption of such products were provided by these imports. More detailed product data cover one-third of total machinery and equipment imports from these countries, and show extrenely high percentages for the equipment needs of certain industries: one-half for the chemical and printing industry and one-quarter for the food industry and for all light industry. Moreover, these detailed product data probably represent fairly substantial, but unknown, underestimates of the true importance of these imports.

Table 1

GROSS IMPORTS AND CONSUMPTION OF MACHINERY AND EQUIPMENT BY THE USSR

Product Classification	Percentage of Total USSR Consumption		
	Total Imports	Imports from Convertible Currency Countries[a]	Imports from Convertible Currency Countries plus G.D.R.
All machinery and equipment, 1970	10.6	2.9	5.4
Specific types of machinery and equipment, 1969[b]			
1. Metalcutting machine tools	21.0	9.4	14.2
2. Forging and pressing equipment	29.1	7.3	25.4
3. Food industry equipment	48.8	9.3	21.5
4. Textile and other light industry equipment	41.4	20.7	26.6
5. Chemical equipment	61.0	39.0	47.0
6. Printing equipment	60.2	27.1	54.5
7. Apparatus and Instruments	6.3	1.8	3.8
8. Agricultural equipment	10.8	0.9	4.4

Notes: Total imports of machinery and equipment as a proportion of total Soviet consumption of machinery and equipment in 1970 were calculated as follows:

Consumption is defined as gross value of production, minus machinery and equipment used as intermediate inputs in current production within the machinery and equipment sector, minus gross exports, plus gross imports. The adjustment to eliminate double-counting within the Soviet production sector of machinery and equipment is 30 percent of the branch's total production; this is given by an experimental planning interbranch balance calculated for 1970, by the Economic Research Institute of Gosplan.

Imports and exports are defined inconsistantly with production, the former excluding consumer machinery products (U.S. Department of Commerce, Foreign Demographic Analysis Division, Description and Analysis of Soviet Foreign Trade Statistics, FER-5, pp. 2 and 89-90, July 1974). This inconsistency of definitions leads to a minor understatement of the proportion of imports to consumption.

The serious problem, however, is the appropriate rate of conversion to use between foreign-exchange rubles (in which foreign trade data are presented) and domestic rubles (used in valuing domestic production). I have followed Palterovich in assuming a purchasing-power parity of 1.8 foreign exchange rubles to 1 domestic ruble. Palterovich says that this ratio was calculated for metalcutting machine tools independently, and by different methods, by two Soviet organizations: the Scientific Research Institute for Machinebuilding, and the State Machine Tool and Tool Design and Testing Institute. Presumably, this is for the middle to late 1960s. While Palterovich does not state the ratio which he uses for all machinery and equipment in his own calculations, my recalculations of his data show that he must have used this ratio or one very close to it.

The 10.6 percent figure for total imports presented in the table can be compared with a 15.8 percent figure given by Palterovich for 1967. Palterovich measures total consumption as the amount of equipment paid for out of the accounts of capital investment, this being his method of eliminating double-counting. However, Palterovich's methodology ignores the use of machinery and equipment as intermediate products and for ordinary maintenance in other branches, expenses which are paid for out of current costs (the 1970 experimental interbranch balance showed this to be 18 percent of total machinery and equipment production). Adjustment of Palterovich's consumption figure for 1967, assuming the 1970 ratio of such transfers, reduces his figure to 11.9 percent. My percentage is understated relative to this since my numerator excludes consumer goods although they are included in domestic production. (Palterovich, Park Proizvodstvennogo Oborudovaniia, pp. 138 and 151.) Of course, the last comparison represents a deficiency in my calculation.

For Western reviews of varying estimates of purchasing-power rates between domestic rubles and foreign-exchange rubles, see A. Woroniak, "Le probleme de la conversion du rouble en dollar," Revue de l'Est, 5, 1, pp. 5-54 (1974), and V. G. Treml and D. M. Gallik, Soviet Studies on Ruble/Dollar Parity Ratios, U.S. Department of Commerce, Bureau of Economic Analysis, Foreign Economic Reports, 4, p. 24 (1973). Treml and Gallik report preliminary results which indicate that the proper ratios for machinery and equipment fall within a rather narrow range of 1.3 to 1.4 foreign exchange rubles to 1 domestic ruble. My use of 1.8 may lead to an OVERSTATEMENT of the share of imports in domestic consumption.

The gross imports of specific types of machinery and equipment as a percentage of Soviet consumption in 1969 include all categories for which official data exist as to both production and imports. The same conversion rate has been used between domestic rubles and foreign-exchange rubles as in the previous calculations.

Here, consumption is defined as value of production, minus gross exports, plus gross imports. No data are available for these subcategories of machinery and equipment which would permit elimination of shipments within the machinery and equipment sector. Given the nature of the subbranches treated, it would be inappropriate to use the average ratio for the sector as a whole. I have thus ignored the problem of doublecounting in the consumption figures, AND THUS I SIGNIFICANTLY UNDERESTIMATE THE PERCENTAGES OF IMPORTS TO CONSUMPTION. (If I were to use the average ratio of such doublecounting in the sector as a whole, my import percentages would be increased by a factor of 1.3.)

a. This was calculated as consisting of imports from all countries except CMEA members and Yugoslavia. For machinery and equipment, this is a very close approximation. However, since the same conversion rate between domestic rubles and foreign-exchange rubles was used in my calculation for imports from all countries, imports from convertible-currency countries are UNDERSTATED.

b. The eight categories of machinery and equipment considered in the table accounted for 28 percent of total Soviet imports of machinery and equipment in 1969, for 37 percent of these imports from convertible currency countries, and for 33 percent of these imports from convertible currency countries and G.D.R.

Sources:

1. Import and export data: Ministerstvo vneshnei torgovli SSSR, Vneshniaia Torgovliia SSSR, yearbooks for 1969 and 1970 (Moscow, Mezhdunarodnye Otnosheniia).

2. Production data for 1970 for machinery and equipment as a whole: Gosudarstvennyi Piatiletnii Plan Razvitiia Narodnogo KHoziaistva SSSR na 1971-1975 gody, p. 346 (Moscow, Politizdat: 1972).

3. Production data for 1969 for specific categories of machinery and equipment: TsSU SSSR, Narodnoe KHoziaistvo SSSR v 1970, pp. 208-19 (Moscow, Statistika: 1971).

4. Percentage used for eliminating double-counting in production of machinery and equipment in 1970: M.M. Gazaliev, I.A. Kushnikova, and T.P. Nikonova in Tokachev and Denisenko, pp. 60-62.

These data show that, to an overwhelming degree in five of the eight subbranches of equipment for which data are available, branches which use this equipment cannot be restrained from introducing technological change because the Soviet supplier industries fail to produce the new equipment which is needed as an input. Of the types of equipment studied, such restraint can be a major factor only for apparatus, agricultural equipment and metalcutting machine tools. Furthermore, of these three subbranches, it has been claimed that 60 percent of the total value of production produced by the Ministry of Instrument-Making, Automation and Control Systems in 1970 met the standard of the leading achievements of native and foreign technology.[25]

These data lead me to conclude that technological change in certain types of production methods must be easier to implement in Soviet industry than is technological change through the production of new products.

III INTEGRATION OF THE CHAIN LEADING FROM BASIC RESEARCH TO NEW PRODUCTS AND PROCESSES

The efficient use of research and development inputs in any national economy is heavily conditioned by the degree to which there is appropriate balance in the chain leading from basic research to the successful marketing of new products. An overly heavy balance in that portion of the chain which ends with the design of new products can be wasteful because of lack of sufficient effort to place the successful innovations into production.[26] Although data as to the proportion of total expenditures which occur at varying links in the chain are notoriously weak,[27] it is perfectly clear that--at least in capitalist countries, and presumably in the Soviet Union as well--expenditures for research and development are a relatively minor part of the chain. For example, a study of successful innovations of relatively complex types of instruments and cameras in American industry showed the following distribution of costs:[28]

	Percent
Basic invention, research, and advanced development	5-10
Engineering and design of the product	10-20
Engineering of tooling and manufacturing	40-60
Manufacturing startup expenses	5-15
Marketing startup expenses	10-25

For most products, the first two stages in the chain probably represent an even smaller percentage of total expenditures.

The risk of failure drastically declines for projects as they are advanced along this chain. The highest-risk expenditures are those in research, which after all constitutes the smallest portion of the total expenses. A careful Soviet scholar, Kvasha, concludes from an analysis of American and

British companies' experience since the Second World War that about 20 to 25 percent of total research and development expenditures have eventuated in a profitable product.[29] Since R&D, which embody the high-variance elements of the innovation process, are concentrated at the earliest and least expensive stage of the innovation chain, this suggests that the process of innovation is to a certain extent subject to planning and prediction. Furthermore, the degree of planning and prediction possible increases markedly subsequent to the R&D stage.

In view of this susceptibility of the process to planning, it is not surprising that the Soviet Union should have developed a national economic Plan for the Development and Introduction of New Technology. Despite earlier efforts at this, the first planning of the overall research and development process in industry occurred in the five-year plan for 1966-1970.[30] Even in 1972, however, the national economic plan and the plan of science and and technology were said to run parallel rather than in tandem. The science and technology plan is said to consist essentially of individual measures, rather than of an integrated whole.[31] Even then, it is said that only 10 to 15 percent of the work done in the various branches on advancing "technical progress" is included in the national economic plans.[32] Some ministries year after year fulfill only 70 to 80 percent of their plan for the introduction of new products, a level of plan fulfillment which would not be tolerated if it related to the regular production plan.[33] In conclusion, it would appear that Soviet planners are not yet far along in genuinely integrating the chain of research, development, and production.

Soviet writers on the subject appear to be fairly unanimous as to the existence of disproportions between the various links of the chain extending up to the point of introduction into production of a new product or process. The main burden of the complaints is with regard to an over-accentuation of applied research at the expense of engineering and design of products and processes.

An example is the following division of national expenditures on research and development:[34]

Type of Expenditure	Percentage of Total R&D Expenditures: USSR (1968)	U.S. (1963-64)	Great Britain (1963-64)
Fundamental research	12.8	12.4	12.5
Applied research	60.3	22.1	26.1
Engineering and design expenditures[a] (development)	26.9	65.5	61.5

[a] The American and British percentages are said to include expenses of "introduction." This appears to refer to the production and testing of prototypes in production plants. If the Soviet data were adjusted to include the production of industrial prototypes, their distribution of R&D would be approximately 10:47:43 (instead of the above 13:60:27); see Nolting, in footnote 34, p. 15.

If these expenditure proportions bear any approximation to reality, Soviet R&D expenditures do appear to be grossly disproportioned.

This disproportion must help to explain the problems which Soviet industry has encountered in putting into production recently completed designs which have already been incorporated into completed and accepted experimental models of new pieces of equipment. The dimensions of the problem are shown in a study of 2,707 such experimental models of equipment and apparatus, all of which were completed during 1968.

Of the 2,707 models, 22 percent were for units of equipment intended to be produced as single units rather than in production lots. Data for

the remainder showed the following plans for their assimilation into production:[35]

	Percent
Assimilated into production during 1968	23
Planned for assimilation into production during:	
1969	38
1970	10
1971	5
Year undecided at the end of 1968	23

The delay by at least one year of the planned assimilation into production of three-quarters of the completed and accepted development projects for new products must have its effect on the modernity of products being produced at any time.

Interesting data are available concerning the proportion of personnel employed in different activities within scientific (including high educational) institutions and in R&D activity in production enterprises.[36] Between 1960 and 1968, while the total number of such personnel increased by an impressive 224 percent, the proportion working on advanced stages of the R&D process declined significantly. The decline was particularly concentrated, however, in the 1960-65 period.

Type of Organization	Distribution of all Personnel (Percentages)		Number of Personnel, 1968 (1960=100)
	1960	1968	
All scientific institutions and in R&D activities in production enterprises	100	100	324
Of these:			
Design organizations	13.9	8.0	186
Experimental bases	45.8	20.4	144

Yet, a Soviet author has claimed, best experience shows that monetary expenditures at the design level (clearly including experimental bases) should be 71 to 75 percent of the total.[37]

The difficulty with the above statistics is that those for design and experimental bases probably exclude similar personnel employed in the industrial enterprises. The number employed here in design subunits declined by 28 percent between 1 January 1965 and 1 January 1969; however, by 1 January 1971 they totaled 141 percent of their 1965 number. The comparable changes for the counterpart of experimental bases was a decline of 8 percent by 1969, and an increase to 176 percent of their 1965 number by 1971.[38] Comparing these rates of change with those shown between 1965 and 1968 for the corresponding functions within the scientific institutions,[39] it would appear that the total number of personnel in design and experimental bases of all organizations fell off even more sharply as a proportion of total R&D personnel than is indicated above for scientific institutions alone.

One might have thought that a socialist country would have an advantage compared to a capitalist economy in establishing more correct proportions (particularly when they are recognized as such) in the number of personnel occupied in different stages of the R&D process. This is because of the greater centralization of decisionmaking power in a socialist country. In fact, however, the Soviet Union has done peculiarly badly in this regard during the first half of the 1960s. Furthermore, the substantial expansion of national science-and-technology planning in 1966 seems at best to have done no more than stabilize the 1965 disproportions. I have seen no Soviet assertions of an improvement since 1968, but published data are lacking.

One further extension of the R&D chain is possible with available information. This is into the sphere of production processes by way of new types of installed equipment.

It is a truism that a large part of technological change takes the form of "embodied" technological change--i.e., it occurs by means of investment in capital equipment. Since the rate of gross investment in

Soviet industry is unusually high by international standards, one might expect that this would give the Soviet Union an international edge in achieving a high rate of introduction of technological change.

In comparison with the United States, however, this does not seem to be the case. For manufacturing as a whole, the calculated average length of service of plant and equipment appears to have been much the same for the two countries during 1963-69.[40] The explanation is the slower pace of scrapping of equipment in the USSR.

Probably even more important in eliminating a potential Soviet advantage in the embodiment of technological change is the fact that Soviet construction periods for new plants are extraordinarily long by international standards. Partly this is because of the perennial overcommitment of investment funds. Partly it is because the low use of subcontracting relations has led to concentration on building very large factories rather than smaller (and thus more quickly constructed) ones which could achieve at least the same economies of scale through specialization.[41] Partly it is because construction organizations have their wage fund attached to the gross value of their output in a given period, and labor productivity measured in this fashion is much lower during the completion stages of construction than in the earlier stages; thus construction organizations have every incentive to postpone completion of their projects.[42]

Even when construction of new factories is completed, the period of reaching normal production conditions is extraordinarily lengthy. This is shown by data as to profitability which emerge from a 1970 investigation carried out by the USSR Central Statistical Office in 1,063 enterprises in various branches of industry[43]:

Category of Enterprise According to the Number of Years Since it Began Production	Profitability (Profit as a percentage of the unamortized portion of fixed capital plus inventories)
All industry, 1969	20.5
Sample enterprises, 1969	
2nd year of operation	0.9
3rd year of operation	3.3
4th year of operation	9.7

The result of the combination of long construction periods for factories and of their lengthy running-in periods is that even factories designed originally with modern equipment and production processes are partially obsolete by the time they begin to produce at their designed production level. Thus what one might have expected to be a Soviet advantage in embodying technological change through high investment rates in industry has turned out to be a major disadvantage by international standards.

The literature does not indicate any particular changes in this situation over time. For example, the average age at which equipment was being scrapped in 1970 was believed by one Soviet authority to be no lower than that observed in studies in the mid-1950s,[44] although one might have expected quicker scrapping due to labor force shortages, and thus the greater need to increase labor productivity.

A possible exception is that there may have been a substantial increase in subcontracting within the machinebuilding and metalworking industries during the 1960s. Data from Soviet interindustry studies show the following for these branches taken as a whole:[45]

Intrabranch Sales as a Proportion of the Branch's Total Expenditures on Materials and Semifabricates

Year	Percent
1959	32.0
1965	47.9-48.4
1970	53.3

These data, however, should be treated carefully, for they may involve comparisons from the Central Statistical Office's input-output table for 1959 with the experimental, planning interbranch balances of Gosplan's Economic Research Institute. The potential significance for our purposes of this apparent change is that it might have led to an increase in the share of smaller, specialized factories in total industrial construction. By reducing the length of construction periods, this should cause some improvement in the speed at which technological change is embodied.

IV THE INFORMATION PROBLEM OF ACCESS TO FOREIGN TECHNOLOGY

Even in countries with the most developed national industrial R&D programs, access to foreign technology plays an important role in making possible rapid technological progress in civilian industry. This is particularly marked for any country whose industrial production is currently at a technological level below that of the world's leader.

Aside from the perusal and monitoring of published foreign literature, foreign technology can be acquired in a number of ways.

(1) The most cumbersome method is by purchasing examples of a foreign product (or of a turn-key plant in order to get a foreign production process) and then copying these examples. If the product or production process is complex, the problem of analysis may be almost as great as would have been the reinvention of the product or process. Certainly foreign technology can be acquired in this fashion, but only by redoing a great deal of the original research and development work.

(2) A much faster method of acquiring foreign technology is through purchasing the blueprints and formulae which go into the product or process. This is the simplest form of a licensing agreement.

While a vast improvement over the first method, this is still an awkward device for transmitting technology. The problem is that much of any technology is kept in the heads of individual engineers, chemists, and foremen rather than being fully incorporated into blueprints and formulae. These parts of the technology are not transmitted in this fashion.

The head of research of a large British electrical company cites, as an example of the difficulties involved, the purchase by a British company of a license for semiconductor devices. Despite the payment of a large know-how fee, the company found that it had to develop its own technology almost to the same degree as would have been needed if it had not purchased

the know-how.[46] Such horror stories are common in industrial folklore in the West. Even an individual company often faces considerable difficulties in building a foreign plant to produce a product with the identical technology used in a domestic plant of the same company--it is not easy to transmit information which is contained only in the heads of diverse individuals in the domestic factory.

> (3) The most efficient means is through the transmission not only of pieces of paper but also of people. The bringing into the country of foreign engineers and foremen who are familiar with the production process or with the problems involved in producing the product, combined with the sending of domestic personnel to the foreign country's plants for on-the-job training, is by far the fastest means of sidestepping the difficulties involved in the second method.

When we look at the transmission of foreign technology since 1945 among developed countries, it is the third method which has been the most widely used.

The main institutional form which such transfers have taken is, however, one which is an anathema to the Soviet system of economy. For this primary form has been one of equity investment (either through the establishment of subsidiaries or through joint ventures) in the receiving country by the company transmitting the technology. As the vice-chairman of the giant chemical firm, Courtaulds, stated, the profits from successful manufacture are one hundred times greater than the profits from licensing another firm. Thus "royalties are a minor source of profits."[47]

Yugoslavia in the late 1960s, and Romania and Hungary in the 1970s, have legalized the joint venture primarily as a device for speeding the technological transfer which equity investment has made possible in other nations. All three countries have made it quite clear that their interest in equity investment does not lie in the aspect of capital transfer, but virtually exclusively in technological transfer. Since all three countries have been hesitant to establish a foundation for the secure earning of that rate of profit which is available elsewhere, none of the three has yet been particularly successful with this device.

While the Soviet government has not as yet accepted the joint-venture device with equity investment for production within the Soviet Union, it has employed other means of bringing in foreigners. The role of foreign technologists in the establishment of the Tol'iatti auto plant and the KAMA River truck plant is a case in point. Another is the development of joint-venture arrangements involving the agreement by the foreign firm to take its profit in the form of output from the plant constructed in the Soviet Union. Despite this, methods (1) and (2) would still appear to be the major procedures available to the Soviet regime for the import of foreign technology.

The sale of licenses can be attractive for foreign companies which see no ready means for gaining direct access to the markets of a given country. Thus the Soviet government might well be able to purchase licenses which French companies, for example, would be unable to purchase (the seller preferring equity investment in France). But generally speaking, licensing firms are unwilling to make the major effort of sending key personnel to the borrowing country for long periods of time; such personnel, if they are genuinely key and are fully up-to-date with the most recent technical developments in the company, are normally more valuable to the firm in its own equity ventures.

Japan, however, might be considered as a counter case. By 1970, Japanese companies had purchased approximately 2,600 different licenses during the postwar years, and the country was said to be producing some 11 percent of its total industrial production under these licenses.[48] The rapid assimilation of foreign technology in Japan would seem to suggest that extensive licensing can serve as an effective substitute for equity finance.

Nevertheless, it should be noted that Japanese licensing has been accompanied for many generations by very extensive travel abroad both by Japanese technologists and by business men. Transmission of technology has not been simply through transfers of pieces of paper, but also by a massive direct-learning experience of Japanese in the foreign factories. While the degree of success which the Japanese have had with licensing--perhaps a unique international case--casts doubt on the argument made above for the advantages to the borrowing country of being hospitable

to foreign equity investment, it is vital to recognize that it has been greatly eased by a flow of people from one country to another.

At present, there is nothing to indicate that the Soviet government is likely to accept in the foreseeable future such massive movement of technologists and production men. The prime obstacle here is political: it would involve the creation of a far more open society than appears desirable to the Soviet leadership.

So long as the Soviet Union remains unwilling to pay the political price of accepting equity investment and/or massive flows of technologists, it seems reasonable to suppose that it will remain severely handicapped in the rate at which it is able to speed technological advance. For it is cutting itself off from major devices used by all developed capitalist nations for the rapid improvement of technology. No basic changes in this regard appear to be occurring.

One minor betterment in the transfer of technology among the various CMEA countries themselves may be hoped for from a recent accord. In early 1973, the CMEA countries signed an agreement for the payment of license fees between one CMEA country and another.[49] Prior to this, licenses were transmitted without charge, and technological information (such as blueprints) were transmitted at the bare cost of transmission. There were complaints that this eliminated all economic incentive for the transfer of technological information, and thus that the degree of such transfer suffered. While this change may lead to some improvement in the situation of all the CMEA countries, the main problem of access to foreign technology is with regard to the West; the change is irrelevant to solving this problem.[50]

V ORGANIZATIONAL PROBLEMS IN THE ABSORPTION OF TECHNOLOGY

Traditionally and still today, the Soviet Union organizes its domestic chain leading from applied research to production of new products and development of new processes in a very different way than has been customary in capitalist economies. In March 1974, new legislation concerning the ob''edinenie (association of enterprises) may be heralding a long-awaited decisive move in the direction of the type of organization which is customary in most developed economies.

The important aspect of this issue, however, is that--as in most organizational matters--there are offsetting advantages and disadvantages of each approach. It seems unlikely that an organizational shift alone will lead to a very major increase or decrease in the rate of Soviet technological advance.

A. The Organizational Issue

In the United States, applied industrial research, development, design and production are normally integrated into a single business organization.[51] Companies receiving R&D contracts from the U.S. Government for weapons development have been preoccupied particularly with follow-on profits from production of the weapons, rather than with the profits to be gained from the R&D contracts themselves.[52] Only in the field of construction and installation of entire industrial production units has design (done by engineering firms) normally been separated from production.

The advantages of such integration are well recognized, both in capitalist countries and in the Soviet Union. Applied research can be

most readily geared to the production, marketing, and financial capabilities of the organization which will be the user if this research is carried on within the organization's own confines. The not-invented-here syndrome of rejecting "on principle" results from outside research is more likely to be avoided. The dangers are reduced of having to redo development and design work in the separate organizations. Personal contact among researchers, developers, designers, and production men is more easily obtained, and such contact can be very important in smoothing the process of implementation of technological change. Integration within the same organization lessens the problems as to incentives which arise from the existence of separate development organizations: that they are relatively indifferent to costs, and that they are often anxious to expand their own capabilities into new areas of development at the expense of increasing the overhead charges on existing contracts.[53]

Some disadvantages of organizational integration have also been stressed. Carl Kaysen, for example, has argued for the separation of R&D from production activities in the award of weapons contracts in the United States. He sees defense contractors' motivations as dominated by production considerations, and thus as favoring those R&D projects--and those approaches to them--which have the least risk of failing to result in production contracts. In his view, in such situations integration reduces innovation.[54]

Within capitalist corporations, the issue of integration primarily takes the form of the degree to which R&D should be a divisional or a corporate responsibility. Making it a divisional responsibility (and in some companies even a factory one) offers the advantages mentioned earlier wherever subunits within the company exercise considerable independence. But the offsetting disadvantage is that divisional and factory managements are primarily concerned with short-run performance and, from that point of view, both applied research and advanced development are essentially cost items which offer no benefits. The research director of one large American company has pointed to the danger that divisional R&D facilities tend to be diverted to "firefighting" current production and maintenance problems.[55]

For the same reason of divisional emphasis on short-run results, new product lines may be operated within production divisions, but have their negative financial results charged to corporate headquarters until they have reached the degree of maturity in production and marketing which allows them to return a normal profit.[56]

Furthermore, in organizationally integrated situations, it is often difficult to retain successful development and design engineers in these functions. Nationwide samples of engineering seniors, taken in 1964 and 1965 in the United States, showed that recent engineering graduates are primarily oriented toward mounting the managerial ladder rather than simply practicing their original specialities.[57] In integrated organizations, such a desired career path usually causes R&D to be perceived as only the first stage of a successful career. When the organization is devoted entirely to R&D, such abandonment of the function is much less likely to occur.

The risks that organizational integration will lead to the slighting of significant R&D activities are just as real in socialist enterprises as in the divisions of capitalist corporations, and for identical reasons. According to a Soviet author, the Czechs had experience in reorganizing research and development institutes into constituent parts of production enterprises, but the experience was unsuccessful. The Central Committee of the Czechoslovak Communist Party evaluated the experience by saying that these reorganized institutes concentrated on R&D themes important to the individual enterprise rather than to the industrial branch as a whole, and that they were loaded with operational work to meet the current needs of production.[58] In addition, the general innovation-reducing aspects of the Soviet managerial incentive system have militated against the integration of R&D and production.

B. Soviet Treatment of the Organizational Issue

Soviet leaders, at least until the recent period, seem to have been more impressed with the disadvantages than with the advantages of integration. On the whole, they have preferred to establish a separate organization to handle each function in the research-to-production chain.

Figure 1 provides a crude outline of the organizations specializing in each part of the process.

Academies of Sciences. As of the end of 1971, personnel in the institutes of the USSR Academy of Sciences constituted only 3.7 percent of total "scientific personnel" in the USSR.[59] While this represented a steady increase in absolute numbers over past years, it was a sharp proportional decline from the situation in 1956 when the corresponding percentage was 13.5 percent.[60] The USSR Academy of Sciences is the main institutional source of basic research in the Soviet Union, while the republic academies appear to concentrate more on applied research.[61] The institutes of the various republic Academies of Science employed 3.9 percent of all scientific personnel at the end of 1971, a decline from 8.2 percent in 1956. Since a rough Soviet calculation of the nature of research done in all academy institutions in the early 1970s showed that 20 to 25 percent was applied research,[62] we may make a crude estimate that some 40 to 50 percent of the research done in the republic academies should be classified as applied rather than basic research.

Higher educational institutions. The amount of manpower devoted to research in the universities and higher educational institutions can only be estimated. In the early 1970s, the total number (not full-time equivalents) of scientific personnel employed in higher educational institutions was over 36 percent of the total number of scientific personnel in the USSR.[63] However, the source may not be including personnel who are paid on the basis of industrial contracts rather than being included in the regular institutional budget.[64]

A. Korol estimated that, in 1960, 50 percent of the scientists in higher educational institutions were engaged in research, and that they devoted 30 percent of their time to such research.[65] If we apply these figures to the 36 percent figure given earlier, then the fulltime equivalents of scientific personnel engaged in fulltime research at the higher educational institutions constitute some 5 to 6 percent of all scientific personnel in the country. However, since the extent of contract-research done by higher educational institutions has greatly increased since 1960, this may represent an underestimate.

Figure 1

ORGANIZATION OF THE SOVIET RESEARCH AND DEVELOPMENT PROCESS

Organizations	Main Activity
Academy of Sciences of the USSR, institutes	Basic research
Academies of Sciences of the republics, institutes	Basic and applied research
Universities and other higher educational institutes	Presumably, applied research with some basic research
R&D institutes under the jurisdiction of the industrial ministries	Applied research and advanced development work
Design institutes and bureaus under the jurisdiction of the industrial ministries	Engineering design of new products and processes, particularly where such design serves the needs of more than one enterprise
Development and design sections included within the compass of production enterprises	Minor development, design, and testing work intended to serve only the needs of the individual enterprise

The actual total monetary expenditures on all research investigations carried out in higher educational institutions in 1969 constituted 4.8 percent of the total planned "science" expenditures for the entire country during 1967.[66] However, since total "science" expenditures may include some expenditures for modernization of production and for the introduction of new technology,[67] and since monetary expenditures on research in higher educational institutions probably did not include any teacher salaries except for research done directly under contract, this percentage figure most likely underestimates the proportion of R&D carried out in these educational institutions. (An offsetting factor, of course, is that total science expenditures were growing rapidly between 1967 and 1969. Also no account is taken of unreported, nonofficial R&D done outside of educational institutions.)

All in all, we should not be far off in estimating that some 5 to 8 percent of Soviet R&D is carried out in the higher educational institutions.

Research in the higher educational institutions appears to be primarily applied rather than basic.[68] In 1969, 78 percent of all financing for investigations carried out in these institutions came from economic contracts rather than from the state budget.[69] In view of complaints that enterprises are reluctant to introduce into batch production the results of such R&D,[70] it may be assumed that these contracts are mainly granted by ministries rather than by enterprises.

Ministerial institutes and bureaus. The proportion employed here of all full-time equivalents of scientific personnel engaged in research and development must be calculated by subtraction.

The academy systems as a whole (both USSR and republic) constitute 13 percent of the total. On the previous assumption that scientists in higher educational institutions should be considered as devoting 15 percent of their time to research and development, they constitute 8 percent of the total. As will be seen below, scientific personnel in the production enterprises can be estimated as constituting about 4 percent of the total. Taken as a residual, then, the ministerial institutes and

bureaus must account for three-quarters of the total. Doubtless they number a still higher proportion of the number of total personnel, rather than scientific personnel alone, who are engaged in research and development.

These institutes and bureaus constitute a very large number. In the machinebuilding branches alone, there were about 170 R&D institutes and some 1,500 design institutes and bureaus. These are quite specialized by type of machine or apparatus being developed, and there are complaints of overspecialization and overlap of tasks and designs.[71]

Specialization has led to considerable separation betweeen R&D institutes and "experimental bases" in which models of the products developed can be produced on a small scale. In 1970, for example, one-fifth of all the ministerial development institutes located in Moscow had no modern experimental base whatsoever, and one-half were without an experimental shop or plant.[72] Of 806 design institutes and bureaus of machinebuilding in 1970, 70 percent were without experimental bases; of those having such bases, only 12 percent of the relevant institutes' and bureaus' personnel worked in them.[73] Even when institutes and bureaus do have such facilities, the plants and shops which belong to them have every financial incentive--in terms of the bonuses earned by their personnel--to do as little experimental work as possible and, instead, to concentrate on the production of batch-output like any normal production enterprise. The reason is that these facilities are under the same bonus regime as are production enterprises.[74]

The result appears to be considerable hampering of the work both of the R&D institutes and of the design institutes and bureaus. Their finished products, which they turn over for production, may indeed require considerable further work within the production enterprise before they are ready to be put into successful batch-production.[75]

Development and design sections within production enterprises. The only data available for employment in these sections is the statement that, as of January 1970, only 8 percent of all scientific workers in the Soviet

Union were employed in production enterprises, design organizations, and in the state apparatus.[76] From this figure, one might presume that a high estimate of employment in production enterprises alone, taken as a proportion of fulltime equivalents of all scientific personnel engaged in research and development, would be 4 percent. Of course, the proportion of all personnel (whether or not "scientific") engaged in research and development in the USSR is presumably a good bit higher. Still, it would be surprising if it were over 10 percent.[77]

Data are also available as to changes in the absolute number of development and design personnel in production enterprises between 1965 and 1971. Their number dropped by 28 percent between January 1965 and January 1969, and then doubled in the following two years.[78] The net change between 1965 and 1971 was an increase of 41 percent, which compares with a 51 percent increase in the total number of scientific personnel in the country as a whole. Thus, while trends have varied amazingly sharply during the short period of six years, the net effect was probably to keep roughly constant the number of development and design personnel working within production enterprises as a proportion of the total number in the USSR.

Although the absence of data makes it impossible to offer a sound judgment, the Soviet literature gives the impression that these sectors within production enterprises do only a minor amount of development and design, and are mainly devoted to reworking the projects taken from the ministerial institutes.[79]

One important factor contributing to this situation is that Soviet wage regulations prohibit development and design engineers who work within production enterprises from earning as much as they would in separate development or design institutions.[80] As might be expected, Soviet writers report difficulties in keeping talented development and design engineers in the production enterprises; one forms the impression that the enterprise staffs in these functions consist of those who cannot find employment in the institutes. Writing in 1966, one author reported that a significant

number of ministerial design institutes were formed out of successful design bureaus of production enterprises--and that the motivation for such organizational separation of design work from production is to raise the pay of the staff (and thus, presumably, to be able to hold them within the design organization).[81] In 1973, another author wrote of all technical organizations striving to be recognized as separate R&D organizations striving to be recognized as separate R&D organizations, rather than being parts of enterprises.[82]

C. The Development of Ob''edieniia (associations)

Beginning about 1964,[83] there was resuscitation of an old Soviet organizational form in industry which had gone out of fashion in the early 1930s: the ob''edinenie, or association of enterprises. In that year, 410 of them were created to combine 1,860 enterprieses.[84] Little further growth had occurred by late 1970, when there were 510 production ob''edineniia in industry, combining 2,211 enterprises.[85] By the end of 1971, however, about 900 of these production ob''edineniia existed. They included 11 percent of all industrial employees, and were responsible for 10 percent of all industrial sales.[86] Thereafter, there was little further expansion: a total of 1,100 production ob''edineniia existed in May 1974, combining 4,500 enterprises. Renewed expansion was not expected until after 1974.[87]

The most detailed statistics as to the types of ob''edineniia exist for the end of 1971.[88] A total of about 1,149 of all types existed.

- Production ob''edineniia. These numbered 879, and included 3,655 factories. Each was based on a single head-enterprise, which served as the headquarters. Branch breakdown (by number of ob''edineniia):
  - light industry 33 percent
  - food industry 16 percent
  - lumber and wood industry 10 percent
  - electrical equipment industry 3 percent
  - others 38 percent

- All-Union ob''edineniia. There were somewhat over 32 of these. Branch breakdown:

  - chemistry — 17 ob''edineniia
  - apparatus construction — 12 ob''edineniia
  - light industry — 3 ob''edineniia

- Territorial ob''edineniia. There were somewhat over 141 of these.[89] Branch breakdown:

  - meat and dairy industry — 56 ob''edineniia
  - coal mining — 46 ob''edineniia
  - petrochemicals — 22 ob''edineniia
  - light industry — 17 ob''edineniia

- Scientific-production ob''edineniia. About 70 of these existed: mainly in chemical and oil machinebuilding, in apparatus construction, in the electrical and electronic equipment industries, and in machinebuilding for construction, road, and communal equipment.

Examination of the industries in which all the ob''edineniia, except the scientific-production type, are concentrated suggests that the aim of improving the implementation of new technology did not play a major role in the development of this organizational form.[90] Its prime function has been that of improving current operations.

It is only the scientific-production ob''edineniia in which the hope for improved implementation of R&D played a decisive role. Each of these ob''edineniia includes at least one R&D institute, with engineering design subdivisions, and production enterprises intended to put the newly developed products into batch production. The head organization of the ob''edineniie was intended always to be an R&D institute rather than a production enterprise. This form was created about 1968, and clearly constituted the potential for a significant organizational break with Soviet tradition.[91]

A number of Soviet commentators have spoken highly of the performance of these scientific ob''edineniia. However, the head of a prominent scientific-production ob''edinenie, writing in 1973, considered that half-hearted organizational reform had frustrated the hoped-for gains from the new organizational form. Wherever (as in the writer's own ob''edinenie) the R&D institutes and design bureaus retained their separate legal identity and economic

accountability (khozraschet) status, he regards the ob''edinenie form to be essentially fictitious.[92] Each of the R&D, design, and production organizations would go its own way within the ob''edinenie--responding to its own individual financial incentives--in the same fashion that it had earlier within the chief administration (glavk) of the ministry. The author argued that the only solution was to abolish legally independent R&D institutes within the industrial ministries, except for a very small number in the country as a whole, and to treat the others and the design bureaus simply as subunits of the ob''edineniia with no independent rights of their own.[93]

No information is available as to the proportion of R&D institutes and design bureaus within ob''edineniia which retain their independence in the fashion described above. But that it may not be the exception is suggested not only by the tone of the above article but also by the experience of former production enterprises which were merged into ob''edineniia: as of early 1974, 60 percent of these latter had retained their independence. Data for 296 production ob''edineniia show that it has been primarily the small production enterprises which have lost their independence.[94]

In the spring of 1974, the Soviet Government legislated a new development: in the future, all units within ob''edineniia should be stripped of their legal independence and of their economic-accountability status.[95] True, this applied specifically only to production ob''edineniia and not to the scientific-production type, but it may have been intended for all. Nevertheless, it was clearly motivated--at least primarily--by production considerations; it was a response to the view that many production ob''edineniia are only formally listed as such and, in fact, remain loose combinations of isolated enterprises.[96]

Implementation, however, is a matter for the future. This legislation was a continuation of a resolution of early 1973 calling for the substantial reorganization of the system of administering industry under the individual ministries, with a major expansion of the role of the ob''edinenie.[97] But only in 1975 were the ministries to begin preparing designs for production ob''edineniia and for their extension.[98] The extension and transformation of the scientific-production ob''edineniia seems clearly scheduled to begin even later, if at all.

VI INCENTIVES FOR THE SOVIET PRODUCTION ENTERPRISE: THE GENERAL MODEL

In any organization, a fundamental problem for the policymakers is to develop an internal managerial environment which will cause intermediate and lower-level managers to take those implementing decisions most in line with the objectives of the top policymakers. Nowhere can it be assumed that even explicit central instructions will be implemented, nor can the policymakers in a very large organization provide explicit detailed instructions for more than a very small proportion of policy-implementation measures.

Section V dealt with one aspect of this problem: the organizational. But clearly this is only a relatively minor side of the issue.

A second aspect, but one which will not be treated substantively in this report, is that of creating an atmosphere in which managers at all levels incorporate as major arguments in their own individual welfare functions those factors which are dominant in the welfare function of the top policymakers, and in which the treatment of these arguments is identical in the two sets of welfare functions. By this is meant that intermediate and lower-level managers accept for their own sake the parts of the value system of central policymakers which are relevant to their own decisions and actions, rather than accepting them only because of their reflection in the personal reward-punishment nexus with which these managers are faced.

This is, of course, a long international history of attempts at this type of psychological internationalization; these efforts take the form of selective recruitment and promotion on the one hand, and of socialization efforts on the other. The Russians have attempted such internalization both through political indoctrination and through Communist Party supervision over enterprise managers. The Chinese seem to have gone the

furthest in their reliance on this device. But it is also found in both governmental and private organizations in capitalist economies.[99] Aside from any other weaknesses of this device, an inherent limitation is that it is not likely to be particularly responsive to changing weights in the welfare function of the central policymakers; it is thus, at best, a conservative mechanism with little flexibility to meet changing priorities, although with great flexibility in adaptation to local situations.

Soviet leaders have never had much confidence in their ability to create such an atmosphere, and certainly not with regard to the detailed and changing components of central policy. True, they have always selected managers partly on the basis of political reliability (i.e., demonstrated acceptance of major elements of the leaders' welfare function), and they have mustered a formidable propaganda machine. But since the cost of these efforts has been low in the post-Second World War period, the cost-benefit analysis of such a policy could be positive even if the expected results were rather small.

Instead, Soviet leaders have viewed intermediate and lower-level managers as "economic men"--much as top decisionmakers in capitalist firms are viewed in orthodox neoclassical economic theory. They have perceived their own problem as being that of creating a combined incentive and decision-rule system which would lead such managers, in their own personal and narrow self-interest, to act in the fashion desired by the central policymakers. This is the Soviet administrative counterpart to Adam Smith's "invisible hand."

In the spirit both of Soviet administration and of neoclassical economic doctrine, this report will take the same view as to the motivation of intermediate and lower-level managers. We shall thus be concerned with the personal reward-punishment nexus created for them as it affects their activities with regard to implementing new technology.

The key issue is the level of management upon which to concentrate. The choice made is that of enterprise upper management. The justification for this choice is the following:

(1) For organizations above the level of the enterprise one can, up to the present, rule out the ob''edinenie as a major area of interest for the reasons indicated in Section V. In any case, both in the past and currently, the top managements of ob''edineniia have been faced with much the same reward-punishment nexus as confronts the top managements of production enterprises.

More debatable is the exclusion of the central apparati (including the chief administrations) of the branch ministries. To the extent that they are concerned with the introduction of new technology in existing enterprises, the exclusion of the ministries themselves presents no particular difficulties. The problem is with regard to the construction of new factories.

Operational management in enterprises plays no role in determining either the technology of new enterprises or the products around which the technology is designed. Such new construction is an ideal means of embodying new technology and of introducing major new products into production. Yet our analysis will offer no grip on this method of introducing new technology.

The reason for this omission is that little is known about the reward-punishment nexus of the ministerial authorities themselves. While something might be done with the problem posed by new enterprises--through examining the situation facing the project-organizations which design new factories--this would be a separate research project.

How important is the lacuna in our analysis? The 1971-75 five-year plan called for 18 percent of the operating capacity of industry at the end of 1975 to consist of enterprises which had been first made operational after 1970.[100] Of total capital investment planned for industry during 1971-75, almost 40 percent was to be in new enterprises. Thus this is a serious lacuna--to which future research might well be directed--but not an overwhelming one.

(2) We might also have chosen to examine the reward-punishment nexus of middle and lower managers within the production enterprise. Fortunately for our purposes, their aggregative self-interest lies in the enterprise bonus fund to which we shall be devoting our major attention. But obviously their individual self-interest can deviate from this, although in ways which are heavily conditioned by regulations and interpretations which differ among individual enterprises. This latter is much too complex a subject to treat in this report, but it does not seem likely that successful consideration of it would lead to any significant modifications of the analysis.[101]

A. The Basic Reward-Punishment Nexus

Four major elements enter into this nexus:

- Career changes.
- Size of the bonuses received by the enterprise top managers.
- Size of the bonus fund received by the enterprise as a whole.
- Variations in the wage fund per efficiency-unit of the enterprise labor force.

One might expect that the principal incentive for managerial top managers would be the securing of promotion and avoidance of demotion. During the prewar period in the Soviet Union, career movement was sufficiently rapid so that this was probably the case.[102] But the situation changed rapidly thereafter. Since the middle 1950s, all the available evidence suggests that stability in post has been considerable for all levels of management both at the enterprise and ministerial level. Managerial job stability in Soviet industry seems today to be much like that observed in large-scale French industry, and considerably greater than that in large American industrial firms.[103]

In this situation of clogged managerial career lines, bonuses can take on particular importance as a managerial incentive. This is the case provided that bonus payments are large relative to salary, and that they fluctuate with performance rather than constituting a de facto delayed

salary payment. Both of these phenomena characterize Soviet industry; bonuses appear to be of the same proportion of salary as in large American firms with managerial bonus systems, and to be attached much more closely to the performance of the lowest relevant suborganization. What seems internationally unique in the Soviet bonus system is that bonuses are paid even to the lowest levels of professional and managerial personnel, that they are paid for results over very short periods, and that they are linked to quantitative indicators of success rather than to subjective evaluation of performance.

In examining top-management bonuses, we can in fact deal primarily with the total bonus fund earned by each enterprise. Top-management bonuses do not appear to have any other major source--although one cannot be certain of the latter statement.[104] Since about 1959, national regulations have provided that the average bonus for the group of top managers in an enterprise may be set at no higher percentage of salary than the average for all managerial and professional employees in the specific enterprises.[105] Moreover, it has been illegal since 1968 for the bonus of any individual to vary by more than 25 percent from the average earned by his subgroup within the enterprise.[106] Thus top-management bonuses within any given enterprise can be taken as a fairly well-defined function of the bonus fund earned by the enterprise as a whole. (However, as we shall see below, top-management bonuses may be reduced to zero despite the earning of an enterprise bonus fund. This is the one known exception to the functional relationship.)

Bonuses are paid to all personnel in industrial enterprises according to the results of the enterprise, or even of smaller units within it. Bonuses for managerial (including foremen) and professional personnel--a category constituting 11 percent of the total industrial labor force in 1966--have been particularly substantial. While only some 4 percent of their total earnings in 1934, they rose to about 30 percent in the mid-1940s, fell again to 12 to 16 percent during the years 1960-64, and thereafter continued to mount to 18 percent in 1969, and 20 percent in 1971, in Soviet industry as a whole. By 1969, for those managerial and professional personnel engaged only in mainline activities, bonuses constituted 27 percent of earnings.[107]

When one examines bonus schemes affecting all managerial and professional personnel, one must first be certain that the bonuses are not in fact paid automatically as delayed salary. An analysis of thirteen enterprises over a period of three years (1967-69) provides reassurance in this regard. If we consider the maximum variation in annual bonus payments per managerial and professional employee over the three years within each of the enterprises taken as a single unit, and then average this variation over all thirteen enterprises, we find that the average enterprise variation was 33 percent of its average bonus. The maximum inter-enterprise variation of per capita bonus (taken as a percentage of base salary) in extreme years was 114 percent of the average bonus of all thirteen enterprises taken together.[108] Five other sources which present similar data (some monthly, some quarterly, and some annual) for individual enterprises are confirmatory.[109]

The vast bulk of these bonuses are paid on the basis of monthly and quarterly performance,[110] in contrast to the situation in American and European firms where they are based on annual results. Moreover, they are paid out at once, while managerial bonuses in American firms are usually distributed over the course of several years so that the individual manager's dollar bonus receipts do not fluctuate as much as do his bonus earnings. The Russian practice of linking both bonus earnings and bonus receipts to shortterm results leads to substantially greater fluctuation in total earnings than would otherwise occur.

Enterprise top managers can be thought of as primarily orienting their activities toward maximizing some time-discounted sum of bonus earnings of their enterprise. Partly this is because of the close relationship between the top managers' own bonus earnings and the bonus fund of the enterprise. But also it is because the earnings of their managerial and professional staff depend heavily upon the size of the fund, and thus a high bonus fund is vital both if the enterprise is to be run as a "happy ship" and if the more competent staff members are to be kept from resigning in favor of a post at another enterprise. Successful enterprise performance in the near future is highly dependent upon acceptable bonus-fund earnings in the present.

However, the enterprise bonus is created as a weighted function of several different success indicators. The bonuses paid to top management,[111] on the other hand, are supposed to be reduced to zero if any one of these success indicators falls below the planned level.[112] Thus the effort to maximize bonus-fund earnings is subject to the constraint of 100 percent plan fulfillment of each of the relevant success indicators.

Enterprise top managers must also be concerned with the size of the wage fund received per member of the labor force (this latter being adjusted for relative skill levels). This concern is motivated primarily by the fact that manual workers are not only paid largely according to piecework but also by the fact that bonuses constitute a substantial proportion of their total earnings and are mainly paid out of the wage fund. Lack of a sufficient wage fund, with resulting lower earnings for the manual workforce, must lead to a high quit rate of the more competent and mobile manual workers.

A summary of this section (but one which ignores, for the time being, the wage fund consideration mentioned above) is given in the following model of the objective function of enterprise top management:

$$\text{maximize: } G = f\left(\sum_{i}^{m} a_i I_i\right)$$

subject to:

$$I_j \geq \bar{I}_j \quad \text{("full constraints")}$$

$$I_k \geq \bar{I}_k \quad \text{("minor constraints")}$$

where:

G = objective function of enterprise top management

I = success indicator, achieved

$\bar{I}$ = success indicator, planned

a_i = weight of the i^{th} success indicator in determining the bonus fund

sets i and j are intersecting sets

set k is disjoint from sets i and j

The maximized function above refers to the particular success indicators (I_i) whose weighted average determines the size of the bonus fund for a given period. The full constraints refer to the I_j whose fulfillment by less than 100 percent leads to sharp reduction in the enterprise bonus fund, and/or leads to elimination of bonus earnings by the enterprise's top management.

"Minor constraints" relate to a different set of success indicators (I_k) which affect the future career prospects of individual top managers. The I_k are defined as those success indicators for which nonfulfillment of at least the planned value yields some probability of punishment through the medium of career prospects, but where the expected value of this punishment is very low relative to the expected value of the reward for fulfilling all the success indicators I_i and I_j.

The category of "minor constraints" does not constitute a set of true constraints in a programming sense. Strictly speaking, the I_k indicators should be treated as part of the objective function to be maximized. But the above categorization is preferred as a means of reflecting the following phenomena:

(1) The weights of the individual I_k indicators in the objective function are very low relative to the I_i and I_j--at least up to the point of 100 percent plan fulfillment of each of these latter success indicators. This is a reflection both of the relative importance of career vs bonus incentives in the current Soviet industrial environment, and of the fact that those success indicators which are critical for bonuses are also important for careers.

(2) For the I_k success indicators, there is no payoff for greater than 100 percent plan fulfillment. This reflects the greater concern with career-punishment than with career-reward which seems characteristic (although certainly not universal) among Soviet enterprise top managers.

This model of the objective function of enterprise top management will play a critical role in our analysis. It allows us to concentrate our attention on the small number of I_i and I_j success indicators, and to ignore the much larger number of I_k indicators.

B. A Fuller Model of Managerial Behavior

The above should be considered as a one-period model, in which decisions and actions of managers have no effect on rewards in future periods. An alternative interpretation is that it is a multiperiod model, but one in which the rate of time discount between periods is unspecified. A model which takes account of periodization is the following:[113]

(1) Managers are assumed to attempt to maximize their expected personal incomes over their career horizon, discounted by some time factor.

(2) The proxy for such maximization of discounted future earnings is taken as the maximization of discounted future bonuses expected to be earned while managers hold their current positions, subject to the constraint of avoiding actions which are likely to lead to dismissal.

(3) Managerial bonuses constitute a well-defined function of the degree of fulfillment of a small number of specified plan indicators. This function is highly kinked, with very little or no bonuses being paid for anything less than 100 percent plan fulfillment.

(4) Annual plan indicators (I_i and I_j) are set by ministerial and higher authorities at levels which are quite ambitious in relation to the potentialities of a high proportion of enterprises. The managers of such enterprises are thus unable to fulfill these indicators 100 percent except by violating other plan instructions (I_k) to which bonuses are not specifically attached. The decisionmaking powers of the managers stem from the fact that they must choose which instructions to violate and in what degree; they are guided in their trade-offs by the effect on the total rewards (O) which they are maximizing.

(5) The constraint on managers' behavior (which consists of avoiding actions likely to lead to dismissal) is not overly severe, and leaves a great deal of room for such trade-offs. The justifications for this critical hypothesis are that the ministries are themselves primarily concerned with the fulfillment of those plan indicators to which enterprise bonuses are attached, and that the ministerial staff recognize that such fulfillment is impossible except through violation of other ministerial instructions.

(6) Overfulfillment of plan indicators in one year is followed in the next by the setting of higher planned tasks for the enterprise than it would otherwise have been given. The greater the overfulfillment, the higher the plan in the following year. Enterprise managers are quite aware of this process.

(7) Because of the above effect of overfulfillment, combined with the fact that bonuses constitute a kinked function of the percentage of plan fulfillment (see 3), enterprise managers avoid "too great" overfulfillment in any year. "Too great" is defined as a percentage of plan overfulfillment which is believed to jeopardize 100 percent plan fulfillment in the following year. (This is a further specification of 1.)

This model treats the managers as independent and maximizing decision-makers. Planners influence managerial decisions through their choice of the parameters which affect managerial bonuses: (1) the selection of the particular success indicators (I_i and I_j) which are to influence bonuses, and the weighting of these indicators in the bonus function; (2) the level at which the planned indicators are set for a given enterprise in the current year, and (3) the degree to which the increase in this planned level in future years is influenced by the enterprise's current performance; (4) the shape of the nonlinear bonus function relating achieved performance to the planned indicators. In addition, planners provide the managers with necessary inputs of raw materials, investment funds and goods, and wage fund allocations.

C. The Acceptability of the Model to Soviet Planners

Both Soviet authors and decisionmakers appear to accept as reasonably appropriate for stimulating proper macroeconomic performance all aspects of this model except the intertemporal trade-off by enterprise managers. There have been suggestions and changes with regard to the specific I_i and I_j success indicators used and with regard to their total number. Differences of opinion exist with regard to the degree that enterprise inputs should be centrally planned. But these are all variations within the structure of the model as outlined above.

Fundamental to such acceptability is the view of the enterprise as the operational unit of Soviet industrial administration. Longer term strategy is considered to be fundamentally the concern of the ministries; the desired reduction of ministerial immersion in operational detail is to a considerable degree motivated by an attempt to free the time of the ministries' staffs so that they can devote greater attention to strategic issues. While it would be considered desirable for the enterprises to make more of a contribution to such strategy formulation, there seems no willingness to purchase such a contribution through a lower level of enterprise effort in resolving day-to-day problems. In this sense, the Soviet enterprise is given the same role as the factory and division in most large decentralized American companies.

Also fundamental is the concept of managerial response to financial rewards which Frederick Taylor had had at the turn of the century with regard to manual workers. The incentive problem is perceived as fundamentally that of motivating high effort. Such motivation is best achieved by a composition of earnings which contains a high proportion of income varying in the shortterm with accomplishments; such accomplishments should be defined objectively and simply so that the income recipient can correctly predict the financial rewards which will accompany greater accomplishments; the financial rewards should be given promptly and fully as soon as possible after the accomplishment is recorded, so that the link between the two is reinforced in the mind of the income recipient. In short, Soviet top

managers in enterprises are viewed as responding to incentives in the same fashion which was predicated by classical American industrial engineering for semiskilled workers. This view seems to have gone virtually unchallenged in the Soviet literature on incentives.

What is, however, universally regarded as unfortunate in the model is that its incentives lead enterprise managers both to press for low annual plan targets and, so as to back their campaigns, to avoid substantial overfulfillment in any year. The Soviet literature is unanimous as to the existence of these ill effects. The solution which has been officially pushed since 1965 is to link the evaluation of performance according to at least some of the I_i and I_j success indicators to five-year plan rather than to annual-plan targets. If such linkage could be accomplished, then enterprises would have a much longer period than a single year in which to enjoy what might be viewed as the Soviet counterpart of Schumpeterian monopoly profits from innovation--and managers would thus be less reluctant to overfulfill their plan targets.

The desirability of such a solution seems to be universally accepted by Soviet writers and administrators. Differences of opinion seem to exist, however, as to its feasibility. The results to date have not been encouraging.

D. Annual vs Five-Year Plan Targets

The enterprise fund from which industrial white collar bonuses are currently paid (the fund of material encouragement) began to be formed only in 1966 with the gradual change-over of individual enterprises to the reform system. It was impossible between 1966 and 1970 to link the earning of such funds to any longterm plan, if only because the 1966-70 plan of the economy had already been worked out but had not been subdivided into years for individual enterprises. Even more significant, bonuses could be paid out of these funds only to the degree that additional sales and profits above the earlier-anticipated sums were realized. Branches and enterprises which had earlier been given taut plans were unable to establish

substantial funds. Systems that were established for the formation of the fund in one year (and these varied sharply by individual enterprise) often could not be maintained in the following year because bonus earnings were higher than had been anticipated. Most serious of all, higher authorities refused payment of a large proportion of the bonus funds earned by the enterprises: for 1968, these nonpayments totalled 25 percent of total funds earned in all of industry during the year.[114]

It seems fair to conclude that, during 1966-70, no progress at all was made toward creating the multiyear norms for bonus payment which had been one objective of the 1965 reform. What was done, however, was to introduce an innovation which remained thereafter: enterprise performance which was higher than that called for by the annual plan was rewarded by only 70 percent of the bonus fund creation which would have occurred if the performance had been incorporated into the annual plan--and if the same normatives had been used as were actually employed. This change was designed to give the enterprises an incentive to accept ambitious, but realistic, annual plans.

While this innovation must have been of some help in this regard, the only published Soviet investigation of the matter casts doubt upon its effectiveness. Thirty-five enterprises of the automotive building industry, all of whose bonus funds were created in relation to their success in fulfillment of annual plans for sales and profitability, had their accounts analyzed for the year 1967. The thirty-five enterprises were divided into five categories, dependent upon their planned rate of growth of sales for the year. If each enterprise had exactly fulfilled its plan both for sales and profitability, the bonus fund as a proportion of the wage fund would have been roughly equal among all five categories. In fact, with all groups overfulfilling their plans, the bonus fund proportion to wages was higher for those enterprises with lower planned rates of growth.[115]

The suggested (but not necessary) implication of these results is perverse: that enterprises achieve the highest bonus fund if they are to obtain a relatively modest plan which they then overfulfill. This

implication is likely to hold true even more strongly in the post-1970 period, when the bonus system established for each enterprise has been explicitly such as to give enterprises believed to be in similar positions identical percentages of bonus fund to wage fund provided that they all exactly fulfill their plans.[116]

The reason for the perversity is the following: the planned bonus fund for an enterprise is formed by allocating to the fund a specified number of rubles for every 1 percent improvement over the past year (e.g., in the volume of sales or in the rate of profitability) provided that this improvement has been planned, and 70 percent of this number of rubles if the improvement is above that planned.[117] Where the planned improvement is large, the number of rubles per 1 percent improvement is naturally small. But since payments into the fund for every 1 percent above-plan improvement is a linear function of the payments for every 1 percent of planned improvement, there is a considerable advantage for an enterprise in having a low planned-improvement factor.[118]

The current five-year plan period of 1971-75 has seen an effort to redeem the promise of 1965 to link the bonus fund to a longterm plan. The first stage was that of 1971-73, and was restricted to the level of the branch ministry.

Each ministry was given a global planned bonus fund, to be used to cover the needs of all of its enterprises, for each year of the five-year plan. The planned bonus fund of the ministry would be received if the ministry's enterprises achieved the projected rate of growth of production, and would be increased or decreased otherwise.[119] Where the individual enterprises of a ministry together earned a larger total bonus fund than that earned by the ministry, the difference was to be absorbed back into the state budget by reductions during the following year in the funds which could be earned by the enterprises.[120]

It is not certain if this procedure was in fact instituted before 1973, but it was certainly used in that year. Then, on the basis that

their annual-plan targets for 1973 were lower than their five-year plan targets for the same year, a minimum of four industrial ministries had their planned bonus fund for the year reduced.[121]

Five-year plan systems took effect at the level of the individual enterprise and ob''edinenie at the beginning of 1973, although these were still somewhat tentative. In any case, however, they applied only within the limits of the total bonus fund earned by the entire ministry.[122] The individual ministries were given some discretion in determining the specific indices to which the enterprise bonus funds should be linked, but such discretion does not seem to have been great.[123] Although it was considered desirable to establish bonus systems which use the same percentages of various indices in application to a group of reasonably homogeneous enterprises, this attempt does not appear to have progressed far.[124]

A further move to encourage ambitious annual plans was taken in 1974.[125] This refers to enterprise "counterplans."

After an enterprise receives its official annual plan, it is encouraged to develop a more ambitious counterplan--which must, however, be reviewed and accepted by higher authorities before it goes into effect. The advantage to the enterprise of a more ambitious counterplan is that the reduction in receipts for bonus funds which applies to above-annual-plan accomplishments is eliminated if these accomplishments are within the counterplan limits. Second, both planning organs and organs of materials-procurement are instructed to help the enterprises to obtain the additional inputs necessitated by more ambitious counterplans. On the other hand, there is no penalty with regard to the bonus fund if the counterplan is not achieved, so long as the original approved plan of the enterprise has been achieved.

It can thus be seen that Soviet authorities have been making serious efforts to encourage more ambitious planning at the enterprise level. It is, of course, too early to tell how successful these efforts will be. But one may be sceptical of likely results for three reasons.

First, of course, is the past Soviet record. Second is the inherent difficulty of the problem. Production rates, and profitability to even a greater degree, are quite sensitive to the precise product mix of goods which an enterprise produces within a given year.[126] Since it seems highly unlikely that good predictions can be made centrally five years in advance as to what will be the product mix required of a given enterprise in a given year, a viable long-term linkage of bonus fund to production growth, and profitability seems unlikely. Indeed, it seems to be this product-mix problem which most bothers those Soviet authors who are sceptical of success. Of course, the problem is easier as one mounts to a more aggregative level: i.e., the ministry. But the potential gains are also smaller.

Third is the apparent experience (as interpreted by F.M. Scherer) of the U.S. Department of Defense in the treatment of a similar problem in weapons acquisition: that of contract negotiation. Contracting firms, in choosing preferred forms of contracts, have opted for contractual forms which provide them with a lower expected value of profits, but also with a lower risk of loss, than would alternative forms.[127] Where high profit rates have been earned on individual incentive contracts, many American firms have preferred voluntarily to return to the government what they considered as "excess profits": between 1951 and 1961, defense contractors made voluntary price reductions and profit refunds totalling more than one billion dollars. One reason given by some firms is that high profits on one contract lead to excessively tough bargaining by the government on later contracts.[128] An examination of contractor performance under different contractual forms fails to show those differences in experience with cost overruns and underruns which might have been expected from their differential incentive effects; this can be explained by the influence of contract negotiations (in setting loose or taut cost targets) dominating over the incentive effects of the form of contract in determining the degree to which targets will be undershot or overshot.[129] The parallel of all this to Soviet determination of enterprise plans is that Soviet enterprises might be expected to be wary of plans which have an expected value of very high bonus-fund creation, since such plans would carry additional risk both of failure and of tougher five-year plans in the future.

E. The Issue of Risk Taking by Enterprise Management

A major problem affecting the implementation in production enterprises of research and development results is the issue of the incentive for risk taking. For major new products and processes, such implementation is relatively high-risk compared to the normal enterprise activities. This is also true, of course, for enterprises in capitalist economies. Where the difference between socialist and capitalist enterprises lies is in the rewards for successful risk taking.

If we think of American industry, the potential rewards in smaller and medium-size enterprises, where ownership and top management are likely to be closely linked, arise primarily out of equity ownership by the top managers. If we consider larger enterprises, where top management and ownership control are largely separate, top management still has a large equity stake. Partly this stake is because of direct ownership of shares in the company (even if a tiny minority within a large firm); partly it is because of the possession of stock options.[130]

Such an equity stake in successful risk taking seems impossible to create in a centrally planned socialist economy.[131] To provide it would require the social acceptance of major differences not only in income but also in wealth among the population. In any case, there have been no suggestions in the Soviet Union of any move in this direction. Bonus rewards, of course, might be given; but they could scarcely be of a magnitude sufficient to substitute as an incentive for an equity position.

The only substitute which seems likely as a major incentive to top management could be promotion. Doubtless this may work for some managers. However, one might suspect that it would be dangerous to link major promotion--which would often have to be to a high ministerial post to be worth while for an enterprise manager--to successful risk taking. A bold risk taker might be a very dangerous man to install into a control position such as that of a vice minister, particularly if most such posts were filled on this basis. Industrial practice might become reckless indeed.

Thus one would suspect that, although successful risk taking would enhance a manger's visibility as a candidate for high promotion, a decision as to his actual appointment would lean more heavily on other criteria.

Here, then, we have a major problem for research and development implementation which seems inherent in a socialist economy of the type of the Soviet Union. No good substitute for an equity position in the enterprise by the top managers seems to exist. Risk cannot be counterweighed by very high potential gain for the decisionmaker.

F. Specific Success Indicators Affecting Managerial Incentives

In Figure 2 we return to the reward-punishment model treated earlier, and relate incentives to specific success indicators. Our purpose is to evaluate the relative importance of individual success indicators. For the reasons indicated in the model, we shall concentrate on the I_i and I_j indicators: i.e., on those named specifically in Figure 2. The I_k indicators are relatively unimportant in the incentives of enterprise managers, and we shall thus ignore them.

Turning first to the indicators which affect the enterprise bonus fund, the indicator of production (valovaia produktsiia) does not directly enter into the determination of the enterprise bonus fund; but, as we have seen earlier, it appears to be the most important indicator determining the total bonus fund available for each branch ministry during 1971-75. While it plays no official role in the bonus fund of the individual enterprise or ob''edinenie, it seems reasonable to presume that it must be a very important unofficial determining factor.

Through 1970-71, the size of the individual enterprise's bonus fund was directly determined essentially by two indicators: the rate of profitability[132] and the amount of sales.[133] A third index which also deserves mention is the absolute amount of profits: this was used exclusively as a substitute for the amount of sales for a minority of industrial enterprises. The quantitative dimensions of the attachment of the bonus fund to these success indicators are shown in Table 2.

Figure 2

MANAGERIAL INCENTIVES AND SUCCESS INDICATORS

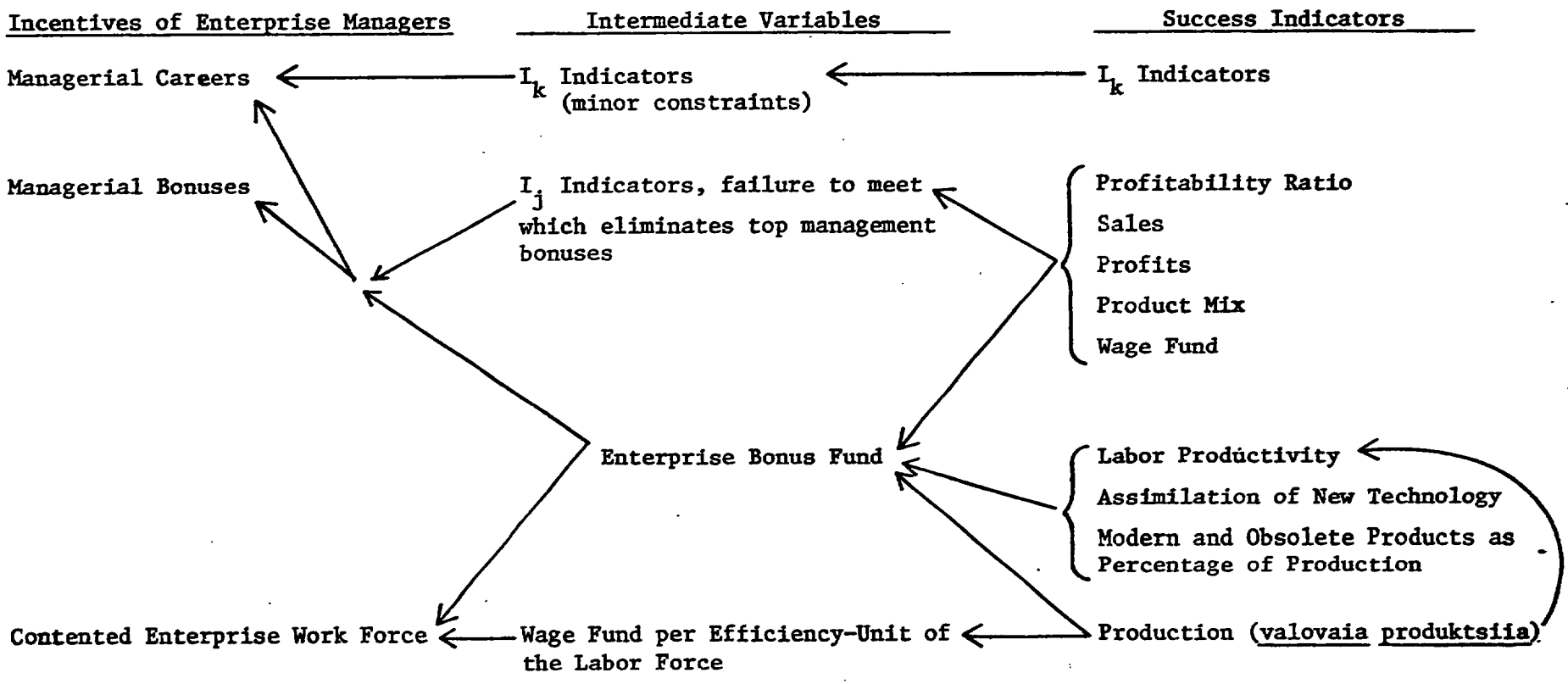


Table 2

DETERMINATION OF ENTERPRISE BONUS FUNDS:
RELATIVE IMPORTANCE OF VARIOUS SUCCESS INDICATORS
FOR ALL INDUSTRY, 1968-70

Success Indicator	1968	1969	1970	
			First Half	All Year
Rate of profitability	61	61	58	59
Amount of sales	29	27	29	30
Profits earned	7	4	5	4
All other indicators	3	8	8	7

Sources: 1968, 1969, first half of 1970, as percentage of moneys actually paid out of the bonus funds: Maslova, pp. 216-20. Full year 1970: Garetovskii, p. 164.

For industry as a whole, indicators other than these three played an insignificant role: 3 to 8 percent. However, it can be estimated that they were much more important for the branches (including machinebuilding) which are included in the Soviet definition of heavy industry: for 1970 as a whole, this miscellaneous category accounted for close to 20 percent of the enterprise bonus funds in heavy industry.[134]

Through 1970, only two success indicators have been shown as existing in the "all other" category. The first is one which particularly concerns us: bonuses for the development and assimilation of new technology. The second is the indicator of product mix. No moneys are paid into the bonus fund as a reward for fulfilling the product mix planned for the year for the specific enterprise; however, if the planned product-mix proportions are not met, the individual branch ministry follows a scale which it itself establishes for reduction of payments into the bonus fund.[135] Apparently, however, other minor indicators also existed in individual subbranches and enterprises.

In industry as a whole, bonus payments for the development and assimilation of new technology remained fairly constant as a proportion of total payments from the enterprise bonus funds: 2 percent annually between 1968 and 1970.[136] While doubtless they were higher than average in the machinebuilding branch, even here they were quite modest: about 10 percent in the electrical equipment industry[137] and in the heavy machinebuilding industry.[138]

The period since 1970 seems to have seen some increase in the proportion of enterprise bonus funds which is tied to sales rather than to profitability, but the change here has not been drastic.[139] Rather, the only important changes have been the creation of two new success indicators beginning in 1972-73.

A decree of May 1972 made fulfillment of the enterprise's five-year plan of labor productivity a new element in the bonus fund. Starting in the same year, the earned enterprise bonus fund was to be increased or decreased by one-third of wage fund under-expenditures or over-expenditures, using the five-year plan for labor productivity as the base of comparison.[140] Unfortunately, no data are available as to the quantitative significance of this new success indicator.[141]

A second new success indicator was introduced in 1973, but apparently only in the electrical equipment subbranch. This was an attachment of the enterprise bonus fund to the proportion of output which was regarded as "modern" or "obsolete" in design. The use of this new indicator was planned to increase the bonus funds of the electrical equipment subbranch by 10 percent in 1973. It was intended for future introduction into other subbranches as well; but the precondition for such introduction was a careful categorization of each product of a subbranch into one of the three categories used to designate the degree of modernity.[142]

To summarize this section, we can see that the size of enterprise bonus fund has been determined almost completely by general success indicators rather than by those specifically calling for the implementation of new technology. Only two success indicators are specifically related

to such introduction: one of these two has, up to now, been restricted to a single subbranch, and both are of very minor quantitative importance. Nor do either of these two success indicators constitute plan indices which top managers must fulfill under penalty of failing to receive their own earned bonuses. Only the product-mix indicator, of the ones which are significant for bonuses, might require the introduction of new product designs; the issue of whether or not it does so will be reserved for Section VI.

Let us turn to the determinants of the wage fund of the enterprise. This fund is closely attached to the value of production, measured in constant prices.[143]

If an enterprise's wage fund for the year is overspent, payments from the enterprise bonus fund are reduced by up to 50 percent. For upper managers, bonuses are completely eliminated if the wage fund is overspent.[144] Moreover, above and beyond the effect on white-collar bonuses, the wage fund is of critical importance for maintaining a contented manual labor force.

While white-collar personnel receive almost all of their additions to basic salary out of the enterprise bonus fund which is formed from profits, the variable earnings of manual workers come primarily from the wage fund which is a cost of production. In 1969, despite a considerable reduction in this proportion during the previous decade, 57 percent of all industrial manual workers were paid by piecework,[145] and apparently a substantial proportion are able to earn well above standard wages for their skill category.[146] Aside from piece-rate earnings, some two-thirds to three-quarters of manual-worker bonuses came from the wage fund rather than from the enterprise bonus fund.[147] Thus it is the wage fund, rather than the enterprise bonus fund, which is of primary importance to manual workers. An enterprise which earns an insufficient per-capita wage fund (for a labor force of a given skill composition) will soon be struck by a high quit-rate among its better workers, and its performance will be virtually bound to decline in the near future.

The importance of the size of the wage fund for a contented workforce and, thus, for performance in the nearterm, raises further the significance of the success indicator of value of output in constant prices. We have already seen the importance of this indicator in determining the amount of total planned bonuses available for the ministry as a whole, in affecting the available wage fund which in turn functions as a constraint on the payment of any bonuses to upper management, and in acting both through the wage fund and through the labor productivity index on the size of the enterprise bonus fund. Adding together all of these effects, an enterprise's value of output measured in constant prices is still today probably as important a success indicator as exists in the eyes of enterprise managers and their ministerial superiors.

VII INCENTIVES FOR THE SOVIET PRODUCTION ENTERPRISE: ASSIMILATION OF NEW TECHNOLOGY RELATED TO SUCCESS INDICATORS

Section VI has presented a general model of managerial incentives in Soviet production enterprises. The task of this section of the report is to apply this model to our interest in the assimilation of new technology.

After having earlier justified a concentration upon success indicators, and having eliminated the I_k indicators from the center of our concern because of theirminor role in managerial incentives, Figure 2 related the nine I_i and I_j success indicators to specific incentives. Figure 3 continues this analysis by singling out for attention six factors which have major effects on one or more of the nine indicators. All of these factors are closely related to the problem of assimilating new technology.

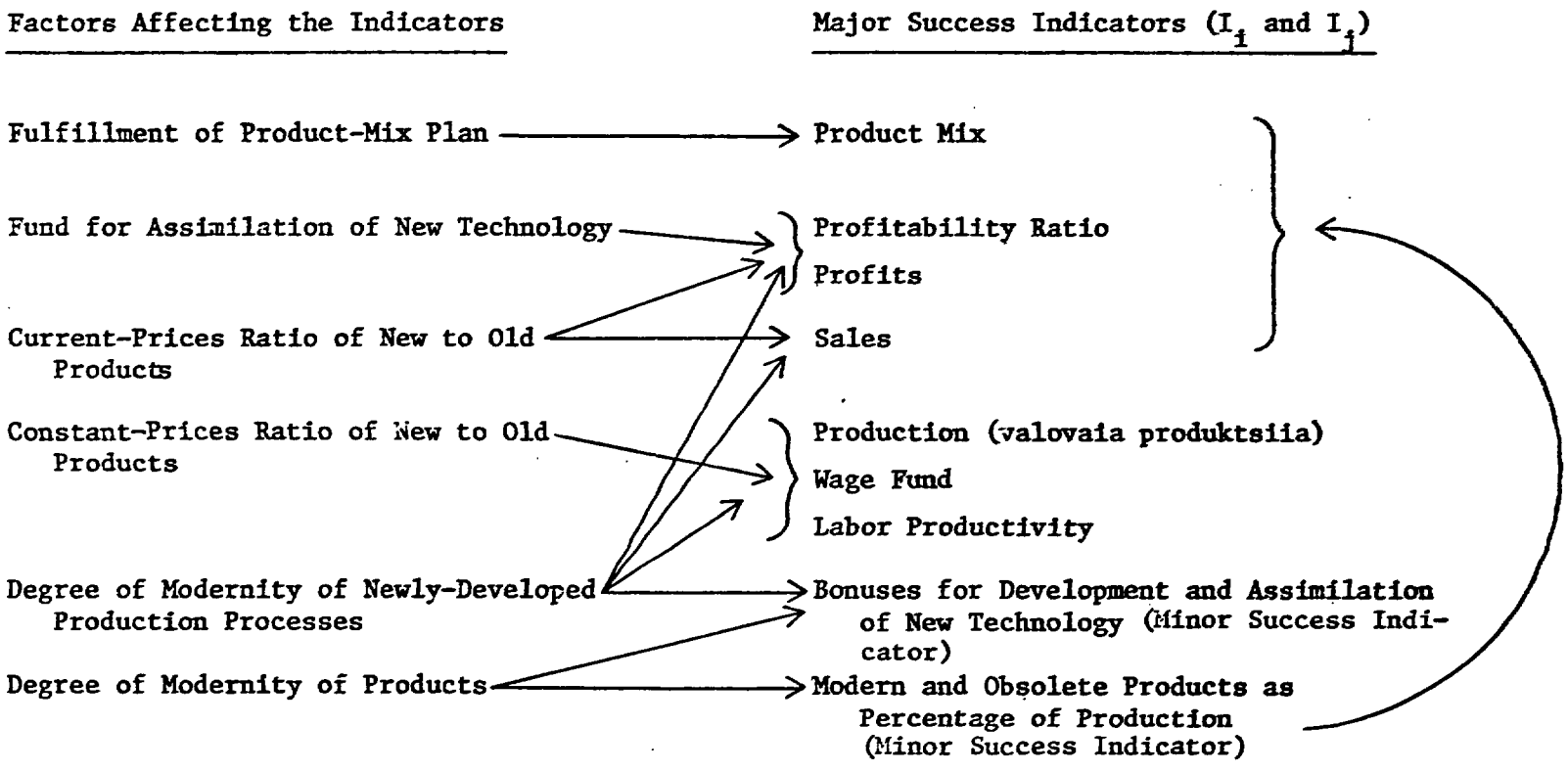
A. The Product-Mix Plan

The most obvious means of providing an incentive--albeit a negative one--for the introduction of new technology in the production program of an enterprise is through the enterprise's product-mix plan. According to the one source which I have seen that discusses the matter, the enterprise's bonus fund must be sharply reduced when this plan is not met, and upper managers are to be totally deprived of bonuses.[148] To the extent that individual new products are entered into the annual plan of the enterprise (and this would be in specified quantities of output), managers can be highly motivated to assure the meeting of ministerial expectations.

Aside from a major question as to the degree to which the product-mix plan is in fact used as a significant influence on bonuses,[149] the product-mix plan was highly aggregative until July 1974. To take three examples in the Machine Tool Ministry: two plants in 1970 produced about 200 and 2,000 (respectively) different types or sizes of products, but their

Figure 3

FACTORS AFFECTING MAJOR SUCCESS INDICATORS



product-mix plans were aggregated into 3 and 9 groups respectively. A third plant was calculated to have fulfilled its 1969 product-mix plan by 93 percent; however, had this been defined in terms of meeting contractual requirements for shipping the precise products in the appropriate quarter, fulfillment would have been only 65 percent.[150] A similar situation existed in the 1970s in the Kuibyshev ball-bearing plant: there were over 2,000 different types or sizes of products which the product-mix plan aggregated into nine groups.[151] I have the impression, although it is no more than that, that new and old products have not normally been categorized into different groups within an enterprise's plan.

Moreover, procurement policy in Soviet industry is said to be based not only on the prior distribution to firms of supply-allotments which total to the planned amount of production (plus planned changes in stocks and net imports) but also on the prior distribution of allotments from expected plan overfulfillment. This places enormous pressure on producers to meet their quotas of total production, and often this can be done only by violations of their product-mix plans.[152]

Thus, at most, use of the product-mix plan can impel timely introduction into production, and in appropriate quantities, only of products which individually are of major importance for the enterprise concerned. Given the large size of Soviet enterprises, only a limited number of new products can be treated in this fashion.

As of July 1974, fulfillment of the product-mix plan was to be defined in terms of the fulfillment of contracts with individual purchasing organizations--i.e., without aggregation of all sales, regardless of customer. However, the tone of the article which described this change did not suggest that it was intended as a means of encouraging the assimilation of new products. Moreover, it was correctly pointed out that it would serve as a stimulus to firms to attempt to bunch their orders in shipments to as few customers as possible--thus working against the desired industrial tendency of developing subcontracting.[153] It is, of course, too early to guess what

will be the effect of this new definition; but one may be skeptical as to both its retention and enforcement.

At least up to the present, one may suggest the following incentive effects of the enterprise product-mix plans:

- They have little effect on assimilation of the mass of new products, each of which is individually minor in the enterprise's planned production program.
- They may be important for the assimilation of individual major new products. However, the general Soviet disregard of product-mix plans in discussion of the assimilation problem makes it appear doubtful that these plans have been a major instrument even here.

Clearly, this is an important area in which information is lacking. Further research might well be helpful here, although it is not at all certain that it would reveal much additional information.

B. Fund for the Assimilation of New Technology, and Other Centralized Funds

Beginning in 1960, a special fund was created to partially finance the assimilation of new technology by enterprises. The fund is centralized within individual branch ministries, and then allocated to meet enterprise requests.[154] In this respect, it is quite similar to the Fund of Development of Production and perhaps to certain allocations from the State budget.

The purpose of these various funds, and particularly of the Fund for the Assimilation of New Technology, is to relieve enterprise budgets of some costs which, at best, would have a financial payoff for the enterprise only in future years. Since, as we have seen in Section VI, enterprises are treated as operational units whose work is evaluated according to short-run results, assimilation costs should properly be either capitalized by the enterprise or covered out of grants made to the enterprise. Bank loans may be considered as a form of capitalization of such expenses; the Fund for the Assimilation of New Technology serves as a source of grants.

For a given volume of assimilation work carried out by an enterprise, a larger grant reduces the financial costs borne by the enterprise itself; it improves the enterprise's performance as measured both by its profits and its profitability ratio. The Fund can therefore be viewed as a means of reducing the disincentives which would otherwise exist for an enterprise to carry out such assimilation activity.

At best, however, it could only ameliorate the disincentives, since its effects are purely financial. It does not touch the problem that assimilation work by the enterprise uses up both capacity and manpower resources, and so negatively affects performance as measured by sales, by production defined in constant prices, by labor productivity, and by wage-fund usage.

Nevertheless, since financial indicators are important to the enterprise, it is worth examining the degree to which the financial costs of technological assimilation are met from this fund. The only detailed Soviet study of this question which seems to have been reported is one in 1968 which covered a "large group of industrial firms." In fact, the sample enterprises accounted for 59 percent of all "expenditures on new technology" spent by the nation's industrial enterprises during that year. Table 3 presents some of the results of the study.[155]

One can see from Table 3 that the Fund for the Assimilation of New Technology is important primarily in financing the assimilation of new products, and not of new processes. What really matters, however, is that the "other" category--which seems to consist mainly of enterprise current costs--constitutes 40 percent of the financial costs of assimilation of both products and processes. Furthermore, the financial costs of assimilation are, by all Soviet accounts, grossly underestimated. Therefore, it would seem reasonable to guess that the enterprises are left with the burden of something over half of the full financial costs of the assimilation process.

This large residual for enterprise current costs within the operating year should, taken by itself, discourage enterprises from undertaking

Table 3

SOURCES AND USES OF EXPENDITURES ON NEW TECHNOLOGY IN INDUSTRY, 1968

Use	Source				
	Total	Fund for the Assimilation of new Technology	Fund of Development of Production	State Bank Loans	All Other[a]
	(percentage of grand total)				
Assimilation of new types of industrial products[b]	15.0	6.8[c]	1.6	0.8	5.8
Introduction of advanced technological production processes	34.4	4.4	9.0	6.9	14.1
Mechanization of production	28.4	2.9	6.2	10.0	9.3
Automatization of production	8.6	0.9	1.9	2.7	3.1
Introduction of automatized control systems	0.7	0.2	0.2	0.1	0.3
All other uses	12.9	1.3	2.7	3.0	5.9
Total	100.0	16.4	21.5	23.5	38.6
	(percentage of row total)				
Assimilation of new types of industrial products[b]	100.0	45.0[c]	11.0	5.0	39.0
Introduction of advanced technological production processes	100.0	13.0	26.0	20.0	41.0

Notes:

a. While this category is not subdivided, the main component appears to be the working capital of the enterprise (i.e., its current operating costs). Other components are amortization funds and loans from the Construction Bank.

b. Presumably, this refers only to expenditures on assimilation during the first two years after the product was first produced in the Soviet Union. Only expenditures on assimilating the first industrial batch are included. (This

definition certainly applies to expenditures for this purpose from the Fund for the Assimilation of New Technology.) As a general rule, only projected rather than actual costs are included here; the difference is covered in normal enterprise costs.

c. In a number of branches of industry, as a rule, this fund is sufficient only for expenditures prior to the beginning of batch production.

Sources:

Garetovskii, pp. 245-46, and L. Orlova and G. TSaritsyna in Voprosy Ekonomiki, 1973, 10, pp. 44-45.

assimilation work which can be avoided.[156] It must be recognized, however, that what matters to the enterprise management is not the absolute level of profits and the profitability ratio, but rather their achieved relative to their planned levels. As a result, an enterprise which engages in considerable assimilation work within a given year is not necessarily worse off than another enterprise which does not; their relative positions depend on the degree to which this difference in assimilation expenses has been recognized in their respective plans. Nevertheless, once its annual plan (and the five-year plan since 1973) has been set, the distribution of assimilation expenses leads enterprise management to hold back on assimilation work to the degree consistent with meeting minimum levels of I_k success indicators.

C. Current-Price Ratio of New to Old Products

The relative current-prices and costs of new assimilated products compared with the-product mix produced earlier by the enterprise is the major factor affecting the three success indicators which most directly and significantly determine the size of the enterprise's bonus fund: the profitability ration, the volume of profits, For a given set of inputs of plant capacity, labor, and materials, it determines these indicators of output.

This current-price ratio plays an especially important role because the Soviet enterprise almost always operates in a sellers' market, where its sales are determined by its production capacity rather than by market demand. In addition to the importance of this price ratio to the seller, we should also be concerned with the degree to which the ratio reflects efficiency conditions for the economy as a whole. In a market economy, the ratio equals the relative marginal utility of old vs. new products to purchasers; when the purchasers use these products as inputs into their own production, the ratio reflects the mix of such input-products which

is most efficient from the standpoint of total national production. In Soviet industry, on the other hand, prices received by the seller are set by authorities above the enterprise level, and the criterion used is not that of market clearance.

In conception in the Soviet Union, the original price of a product is determined by its costs of production, plus a profit determined by a standard rate of profitability for the sub-branch multiplied by a standard volume of productive capital needed to produce it.[157] General price changes have been rare; they occurred in the late 1940s to mid-1950s, in 1967, and for machinebuilding and light industry in 1972-73. Elements of the general process of price formation work in both directions with regard to boosting or depressing the price ratio of new to old products.

The depressing factor is primarily a combination of realizing greater economies of scale over time in the production of individual products, and of the working of the learning curve for both managers and workers. That the composite result can be substantial is indicated by the fact that in January 1973 the average price of batch-produced products of the machinebuilding branch which were produced throughout the period 1967-73 was reduced 12 percent; this price decline being a direct reflection of cost reductions.[158] In the electrical equipment sub-branch of machinebuilding (the only one for which such a calculation can be made, and one in which the average price reduction was much the same as in machinebuilding as a whole), the cost decline during the six years was sufficient virtually to double the profit/cost ratio for products whose prices did not change until 1973.[159]

On the other hand, the price set for a new product takes into account its estimated cost of production, and overestimates of such costs can lead to a sharp boosting of the price ratio of new to old products.[160] Moreover, cost economies which result from the learning curve are sharpest during the first years of production after the new products are assimilated.

(However, a second basic criterion used in pricing new products is comparability with the prices of comparable existing products. To the extent that this second criterion is determining, there is no influence at work boosting the price ratio.)

The clearest, and also most important, conclusion is that the variance of profitability ratios is extremely wide even within the same subbranch. Within a single machine-tool plant in 1970, one major group of products had a 13 percent profit/price ratio while another enjoyed a 29 percent ratio.[161] Data of 1969 for three main administrations of the Ministry of Electrical Equipment showed a dispersion in the profitability ratios of entire enterprises as shown in Table 4.

The data of Table 4 are cited by the table's authors to represent the situation existing in most branches and subbranches of industry. It might be presumed that the variance among individual products would be even wider than that existing among enterprises. Moreover, the authors insist that the product-mix plans for the individual enterprises are so aggregative that they provide little limitation on the detailed product mix chosen by the enterprises.[162]

In view of this wide dispersion, it seems likely that the relative-price incentive for the assimilation of new products must vary substantially among enterprises even within the same subbranch. It must depend upon the profitability currently being earned on different products, whether it is high- or low-profitability products which would be dropped in favor of new ones, and on the enterprise management's estimates of its chances of getting a favorable or unfavorable price for the new product. Thus, on the one hand, it should not surprise us that there has been substantial assimilation of new products in Soviet machinebuilding.[163] On the other hand, we should also not be surprised that the Soviet literature is filled with complaints as to incentive problems in such assimilation.

On balance, it seems likely that the price ratio of new to old products is more often unfavorable than favorable to new product assimilation. While

Table 4

PERCENTAGE OF ENTERPRISES WITHIN A GIVEN CATEGORY OF PROFITABILITY [a]

(Ministry of Electrotechnical Industry, 1969)

Chief Administration	Losses	Profitability					
		Up to 10%	10-20%	20-40%	40-60%	60-100%	Over 100%
		(Percentage of enterprises)					
Apparatus	2	-	10	14	31	32	10
Heavy electrical equipment	-	-	10	60	20	10	-
Electrical equipment	10	3	23	30	21	13	-

[a] Profitability is not defined, but probably refers to the profit/price ratio.

Sources: T. Brazovskaia and V. Petrova in Planovoe KHoziaistvo, 1971, 10, p 22.

there appears to be no broad Soviet study of the subject which defines its terms carefully, the specific subbranch studies I have seen point sharply in that direction.[164] Furthermore, this appears to be the view of Soviet authors on the subject. A major objective of the January 1973 general price revision in the machinebuilding branch, for example, was said to have been to improve the price balance.[165]

Various efforts have been made by Soviet authorities to redress the balance of relative prices. But these efforts have been hesitant, and probably justifiably so given the constraints of the overall Soviet economic system. The argument given against pushing too far in raising the prices of new vs. old products is that it would totally eliminate the desire of user enterprises to purchase new types of machinery or materials.[166] While on the face of things it seems hard to understand why this case has appeared persuasive in the Soviet Union for so long--given the fact of a sellers' market, with the consequence that decisionmaking as to product mix is lodged primarily in the hands of the producer rather than the user enterprises--an underlying logic can be found.

The significant system-constraint is that, so long as prices are set centrally, they cannot be changed too frequently because of the enormous work involved.[167] Over the period of a decade or so of stable prices, great variation in profitability rates among different existing products within the same subbranch is bound to develop.

Given orders of magnitude of such variability as were illustrated in Table 4, it is impracticable to expect that any reasonable set of prices for new products could act as an incentive for the vast majority of relevant enterprises to wish to assimilate the production of new products. This is particularly so because of the risk factor inevitably involved in the assimilation process.

Thus the stripping of user enterprises and ministries of their reason for pressing for new products through the substantial raising of new good prices would be a most hazardous undertaking. There

might then be no desire on the part of either producer or user organizations for the production of new models, and central organs outside the branch-ministry structure would be left in the impossible position of being the sole sources of pressure for this type of technological change. At present, user enterprises and ministries constitute a lobby for the rapid assimilation of new products by producers. It is not surprising that Soviet central authorities have been reluctant to destroy this lobby.

Nevertheless, various efforts--although all rather hesitant--have been made to shift the balance of relative prices.

Temporary prices. The first effort, which predates 1960, was the establishment of temporary prices for new industrial products--prices set at cost-per-unit, plus a profit rate of up to 5 percent of cost, for the first batch.[168] The intent was to provide a minimum economic return to the enterprise even at the early stages of product assimilation, when cost per unit was bound to be very high, while setting the permanent price for the product only after unit-cost had fallen after successful assimilation of the item into the enterprise's production program.

However, the system of temporary prices appears to have been seriously abused. By the mid-1960s these "temporary prices" were being maintained for some five to seven years, and they provided the enterprises concerned with high profits because of the production stage at which the cost base was determined.[169] In 1964, 32 percent of all the production of the machine-building branch was covered by such temporary prices.[170]

Despite the fact that such use of temporary prices must have shifted the price ratio of new to old products in a fashion very favorable to assimilation, Soviet authorities in 1966 sharply reduced the scope for the use of temporary prices. After that year, temporary prices are said to have covered only 2 to 3 percent of the output of machinebuilding--rather than the earlier 32 percent.[171] Perhaps this virtual elimination of the system of temporary prices was partly responsible for the apparent fact that the

proportion of obsolete products in total machinebuilding production rose during the latter 1960s.[172]

Price supplements and reductions. During the period since 1969, a system of price supplements and reductions for modernity of product has been used within the Ministry of Electrical Equipment. The system was extended to machinebuilding in general as of January 1973.[173] In practice, price supplements, but not price reductions, have been used for electrical equipment;[174] no data appear to be available for more recent practice outside of this subbranch.

In the Ministry of Electrical Equipment, products are characterized into one of three categories: the top category refers to those products whose technical performance is considered to reach the highest achievements of native or foreign technology; the third category refers to obsolete products. Basic price is determined in the customary fashion of cost plus a standard subbranch rate of profitability (on production capital). Goods in the third category were to have this basic price reduced, but this instruction seems not to have been followed. Goods in the top category have been eligible for a price supplement, which is taken as a proportion of the economies achieved for the user by having this product available in lieu of the substitute product it replaces.[175]

In principle, price supplements can be up to 100 percent of the normed profitability for a corresponding group of products (50 percent prior to 1972), so long as they do not exceed half of the gross economic saving in a given year to the national economy. In practice, the price supplements--where they have existed--have been 4 to 5 percent of the estimated one-year saving to the user. Moreover, price supplements remain in effect for only one to two years.[176] The small and extremely short-lived nature of these price supplements would seem to deprive them of any great significance.

Gradually declining prices. A third method of revising the ratio of relative prices of old and new types of machinery is set forth ahead of time a schedule by which prices of specific products are to be reduced

annually. The purpose of this system is to absorb the additional profits which would be made at unchanging prices because of reductions in unit costs due to scale economies and the learning curve.

However, it would appear that not much has been done to implement this system. In 1970, it was still essentially in the data-collection stage as a prelude to implementation.[177] As of 1973, ministerial organs ignored the system's effects in setting the sales and profitability targets of their enterprises, and it is implied that it was still barely in use.[178] What has been done instead is to introduce one-time new prices for individual machinebuilding products in January 1969 and January 1970, and to have a general price revision of machinebuilding products in January 1973.[179]

Summary of developments since 1966. The first half of the 1960s appears to have seen a major de facto shift upward in the ratio of relative prices of new and old types of machinebuilding products. This occurred through the development of the system of temporary prices. On the other hand, it is possible that this did no more than compensate for the secular decline in unit costs of existing products while their 1955 prices remained in force.

The enormous reduction in the use of temporary prices after 1966 would appear to represent a shift in the other direction. The development of two new systems--price supplements and reductions, and gradually declining prices--have had little quantitative effect in the opposite direction. On the other hand, the post-1966 period has been characterized by more frequent price changes for machinery products than had occurred in the previous decade: general price changes in 1967 and 1973, and partial changes in 1969 and 1970.

The net effect of changes since 1966 is unclear. But at best, it cannot have represented much if any of a shift toward relatively higher prices for new products; in all probability, the move was in the opposite direction. Thus no improvement from this point of view has occurred in the incentives for implementation of new technology through new product introduction.

D. Constant-Price Ratio of New to Old Products

Just as the current-price ratio has enormous effect on an enterprise's success indicators of profitability, sales, and profits, the constant-price ratio is of equal importance for the enterprise's indicators of production (valovaia produktsiia), labor productivity, and wage-fund creation.

The general discussion of the previous subsection applies equally to the constant-price ratio (although price supplements and reductions, gradually declining prices, and one-time price changes since 1967 do not apply). However, the constant-price ratio for machinebuilding products is decidedly less favorable to assimilation of new products than is the current-price ratio.

The reason for the difference is that all industrial output in constant prices is still measured in 1967 prices. In the machinebuilding branch, current prices of individual products were reduced in 1967 and 1970, and there was a general reduction in 1973; but constant prices remained untouched throughout. Thus the price changes which reduced the unit value of existing products, when measured in current prices, left these values unchanged when measured in constant prices.

For new machinery products, however, the situation has been different. A new product's basic current price[180] is determined on the basis of the most recent current price of comparable existing products, and ITS CONSTANT PRICE IS DEFINED AS ITS FIRST CURRENT PRICE. Since, as I have argued, current prices of existing machinery products have been declining since 1967, this system implies that the constant-price ratio of new to old products is decidedly more unfavorable to the new products than is the current-price ratio.[181]

E. Degree to which Products and Processes are at International Standards

The degree of modernity of products exerts an influence on the major success indicators of the enterprise only through its effect on the factors

already discussed in this Section. The degree of modernity of processes, on the other hand, has a direct influence through changing the period's output/input ratios as measured both in current and in constant prices.

Since enterprises are expected to show an annual improvement in their output/input ratios (this expectation being expressed in the fact that plans for the coming year are normally higher than the performance levels of the current year), enterprise managements are virtually forced to undertake a constant series of minor process improvements. Without this, they could scarcely meet their expanding production, labor productivity, and profitability targets.

Major changes in production processes are another matter. Major change may well reduce output and raise current costs for at least one or two years; the high rate of time discount of enterprise managers[182] would seem to make such enterprise "investment" unattractive.

Nothing further can be said in this report about these matters. Instead, we shall here return briefly to a subject broached at the end of Section VI: the effect of modernity on minor I_i and I_j success indicators.

Bonuses for development and assimilation of new technology. As seen at the end of Section VI, such bonuses have constituted only 2 percent of payments from enterprise bonus funds in industry as a whole during 1968-70, and almost certainly no more than about 10 percent in machinebuilding. Nevertheless, despite their relative unimportance as a success indicator, they deserve some attention because the assimilation by the enterprise of modern products and processes is intended to directly affect the magnitude and distribution of the sums paid out of these special bonus funds.

While bonuses for these purposes existed prior to 1960, this was the case only in the machinebuilding branch; the bonus system was significantly modified, as well as extended to all of industry, construction and transport, in 1960 and 1964. These bonus funds are established at an enterprise

level, and are set at a percentage (which is differentiated by subbranch) of the enterprise's planned wage fund. However, only some 25 to 50 percent of the bonus fund for assimilation of new technology is left to the enterprise, the rest being consolidated at the branch ministry level for redistribution among industrial enterprises and R&D design institutes and bureaus.[183]

In view of the way that the enterprise bonus fund for assimilation of new technology is formed, it serves as no incentive whatsoever to the enterprise as a whole (since its size in relation to the wage fund is determined by a norm applicable to the entire subbranch), despite the fact that it can be an important incentive to the individuals who receive bonuses from this fund. As to the main part of the fund which is centralized at the branch-ministry level, an important criterion in its distribution to individual firms is that of compensating individual innovating enterprises for reductions in their total enterprise bonus fund which would otherwise occur because of the costs of assimilation.[184] The net effect is that the bonus fund as a whole has only a very weak incentive effect.[185]

Finally, more than half of the moneys paid into this bonus fund for assimilation of new technology has gone unused, or has been spent for purposes other than bonuses. This applies both to the portion of the fund left to the enterprises originally, and to the portion consolidated at the ministry level.[186] For industry as a whole, the unused proportion of the bonus fund increased very sharply during the second half of the 1960s; the high unused proportion throughout was explained by one Soviet author as due to the systematic underfulfillment of planned tasks for assimilation of new technology.[187]

Proportion of output falling into each category of designed performance. This is a success indicator which still has significance, at least for its direct effect on the enterprise bonus fund, only in the electrical equipment subbranch, although it is expected in the future to be extended to other sectors.

As was seen in an earlier subsection, the proportion of products falling into the top category (whose technical performance reaches the highest achievements of native or foreign technology) has been relevant for current-price supplements in the electrical equipment subbranch since 1969; at least in theory, it was extended to all machinebuilding in 1973.

In addition, as described in Section VI, additional or reduced payments to the enterprise's bonus fund have been made in this subbranch since 1973, depending on the proportion of the enterprise's production which falls into the top category or into the lowest one of obsolete products. However, not only are such bonus payments still restricted to a single subbranch, but they are not of major significance even here.[188]

F. Marketing Considerations

By and large, Soviet industry is characterized by a sellers' market, in which the industrial enterprise faces no difficulties in disposing of all its production at the prices fixed by the government. Thus the enterprise has no need to assimilate new products in order to keep its machines running. We have earlier seen that one main incentive for product innovation in capitalist enterprises--that of greater profitability for the successful innovator--does not exist in Soviet industry. The second major incentive under capitalism is that the firm may not survive at all without adaptation to new products; this too is absent in the USSR.[189]

But a buyers' market does exist for a few products: primarily consumer durables. Washing machines constitute a good example of this phenomenon, and offer a case study in which new-product assimilation into production can be examined.[190]

Washing machine production in the Soviet Union peaked in 1970 at 5 million units; by that time, the stock of such machines was 52 per 100 families. But, because consumer demand for traditional models of these machines had to a large degree been transformed into replacement demand,

sales had already begun to decline in 1968. Unsold stocks (essentially at the level of trade establishments) as a proportion of production quadrupled in the three years between 1967 and 1970, and doubled again during the following year. Final sales declined by 25 percent between 1970 and 1973.

One might have expected washing machine enterprises to have anticipated, or at least quickly to have followed, the shift to a buyers' market for these products by converting to more modern models. But in 1972, about 85 percent of the total production of home washing machines consisted of single-tub, hand-wringer machines. About one-third of all washing machines consisted of a model developed 20 years earlier.[191] Yet there was a brisk demand for semiautomatic, single-washing-cycle machines. Fully automatic machines were not produced at all.[192]

Why the slowness of product adaptation by production enterprises? The fundamental reason is probably the relationship which exists between industrial and trade organizations. As unsold stocks accumulated at the trade level, trade organizations tried to reduce their orders of the traditional models. But they were only very partially successful in this; their own plans called for them to purchase a given number of washing machines, and they had to accept what was available.[193] Even in 1972, the relative prices paid to industrial enterprises for traditional compared to semiautomatic models was such as to encourage the continued production of the traditional ones.

Still and all, washing machine enterprises did eventually see their production reduced. Adaptation to other products, or reduction of total output, was forced upon them. Why, then, had they not reacted earlier and more vigorously? Presumably a significant role was played by the high rate of time-discount which our model has postulated in the making of enterprise-management decisions.

Thus, even in the rare cases of products facing buyers' markets, the Soviet record of new-product assimilation has been far from distinguished.

G. Summary

Figure 4 treats four forms of assimilation of new technology, summarizing their probable effects on the industrial enterprise's major success indicators. In order to link these effects to the total incentive pattern which confronts enterprise managers, the reader should refer to Figure 2 of Section VI. The factors of Figure 3 of Section VII, and the significance of each for the relevant individual success indicators, explain why the different forms of assimilation have the postulated effects on the individual success indicators. The distinction in effects between major and minor technological changes rests essentially upon the very high time-discount rate used by enterprise managers (the reasons for which were elaborated in the subsection "A fuller model of managerial behavior" in Section VI).

The conclusions as to the effects of incentives on the degree of assimilation of new technology are the following:

(1) New products which represent major changes from products earlier produced by the enterprise: for these, the net incentive effect is decidedly negative. The one saving element for enterprises which are already in operation is that quantitatively important new products may well be incorporated specifically into the product-mix plan of the enterprise. In the case of individual new products which are planned to represent a major component of the enterprise's total production program in the current year, this consideration may be decisive. But it is unlikely to be relevant for products which are planned, in any given year, to constitute only a minor portion of the enterprise's total production.

(2) New products which represent minor changes from products earlier produced by the enterprise: the net incentive effect for these will differ among enterprises, but on balance is almost certainly negative in the machinebuilding branch.

Figure 4

EFFECT OF DIFFERENT TYPES OF ASSIMILATION OF NEW TECHNOLOGY ON THE MAJOR SUCCESS INDICATORS OF THE PRODUCTION ENTERPRISE

Types of Assimilation of New Technology				Major Success Indicators (I_i and I_j)
New Products, Major Changes from those Earlier Produced	New Products, Minor Changes from those Earlier Produced	New Processes, Major Changes from those Earlier Employed	New Processes, Minor Changes from those Earlier Employed	
-	? (mostly -)	-	+	Profitability Ratio
-	? (mostly -)	-	+	Sales
-	? (mostly -)	-	+	Profits
-	-	-	+	Production (valovaia produktsiia)
-	-	-	+	Wage Fund
-	-	-	+	Labor Productivity
+	no effect	no effect	no effect	Product Mix
+	+	+	+	Bonuses for Assimilation of New Technology
+	+	no effect	no effect	Modern and Obsolete Products as Percentage of Production

Code: + Positive effect of the particular type of assimilation on the specific success indicator

\- Negative effect of the particular type of assimilation on the specific success indicator

How, then, can one explain the rather substantial degree of such product assimilation in this branch which has been shown to exist (see Section II)? The answer partly lies in the varying direction of effect, particularly on the major success indicators of profitability ratio, sales, and profits, for enterprises in varying situations. But doubtless one should also consider the I_k indicator of the proportion of new products to total production; while this is not a major success indicator for managers, it does have some effect upon their careers. If the net effects of this type of product assimilation on the major success indicators is only questionably or mildly negative, many managements might be expected to give consideration to the career aspect.

The net effect of the overall system of success indicators for industrial enterprises has been recognized by the very top level of Soviet leadership, as recently as December 1973, as leading primarily to growth in output; it has been recognized as peculiarly deficient in stimulating improvement in the technical level of the products produced.[194]

(3) New processes which represent major changes from processes earlier employed by the enterprise: the net incentive effect on this type of technological assimilation appears to be more negative than for any other type of assimilation.

How then is it that major new processes are introduced into Soviet industry? One would expect that the answer is that such introduction is heavily concentrated in new investment projects, where the entire complex of incentive patterns discussed in Sections VI and VII do not apply.

(4) New processes which represent minor changes from processes earlier employed by the enterprise: this is the only type of technological assimilation for which enterprise managements have a strong net positive incentive. This is thus the area of technological assimilation in which we might expect Soviet industry to have the greatest success.

Thus process improvement in existing Soviet enterprises should be much more evolutionary, rather than dramatic, than is the case in dynamic capitalist enterprises (although, on occasion, dramatic effects might be achieved, even in existing enterprises, through the importation of foreign equipment; see discussion on pp. 9-13, above). Such improvement should generally remain within the compass of the existing broad technological processes which are currently used; movement in industry beyond this scope might be expected to occur essentially through the building of entirely new factories often using advanced foreign technology and equipment. On the other hand, Soviet enterprises do have considerable incentive to push to its limit the pace of such evolutionary process development.

The net effect on process change (lumping together both pre-existing and new enterprises) has been considerably less favorable during 1971-73 than had been expected by Soviet leaders. The State Planning Commission's calculations were that 47 percent of the increase in profits in industry as a whole during 1971-75 would come from unit cost reductions, with the remainder coming from increases in output. In fact, cost reductions accounted for only 25 percent of the increase in industrial profits during 1971, about 35 percent in 1972, and something over 20 percent in 1973.[195] Thus if profits increased about as planned, cost reductions during these three years were only half of the planned amount. The current state of net process improvement in industrial production must be considered, similarly to that of product improvement, as unsatisfactory by the standards of Soviet top leaders.

VIII INCENTIVES FOR THE SOVIET R&D AND DESIGN INSTITUTES AND BUREAUS

A treatment of incentives as they affect the absorption of new technology into industry naturally concentrates on those which relate to the industrial enterprise. This is why Sections VI and VII constitute the heart of this report. But a few words should also be said about incentives which affect organizations at an earlier stage of the research-production chain.

Given the organizational framework within which this chain of work is conducted (see Section V), interface problems among Soviet organizations might be expected to be severe. Traditionally, bonus incentives for development and design institutes and for design bureaus within the branch-ministry jurisdictions have concentrated upon cost economies in the development of acceptable designs and experimental models.[196] The continued need for such cost incentives is shown by the fact that reasonable rapidity in the mockup of experimental models is still a major problem--and therefore, by implication, cost is as well.[197] Table 5 shows that an average period of 2.2 to 3.9 years was required for this task by different subbranches of machinebuilding in the late 1960s. To a large degree, such slowness reflects deficiencies within the individual development and design institutes, although lack of cooperation among such institutes, and between them and the user enterprises, must contribute substantially to the problem.

Post-1967 developments in incentive formulae for R&D and design organizations have attempted to shift the emphasis from the cost to the quality of the development work done. Profits of these organizations (which we shall take as a proxy for managerial incentives[198]) have been linked not only to cost savings in the R&D and design work itself but also to the calculated economic saving for the national economy which can be attained from the new product or process design.[199]

Table 5

AVERAGE LENGTH OF TIME REQUIRED TO PRODUCE A SUCCESSFUL EXPERIMENTAL MODEL OF A NEW PRODUCT IN THE LATE 1960s

Subbranch of Machinebuilding	Period of Time (Years)
Apparatus	2.2
Construction and road equipment	2.5
Electrical equipment	2.6
Chemical and oil equipment	2.6
Machine tools and tooling	2.8
Automobiles and trucks	2.8
Equipment for light industry and for the food industry	2.9
Heavy, energy, and transport equipment	3.5
Tractors and agricultural equipment	3.9

Note: The period is defined as beginning at the time when work on the experimental model (opytnyi obrazets) is begun. The models include those developed by R&D institutes, design organizations, and industrial enterprises.

Source: G. Glagoleva in Voprosy Ekonomiki, 1973, 2, p. 16.

While this is not indicated, it seems probable that the original data come from a study of 2,707 experimental models which was carried out in 1968 by the statistical organs. The average period needed to produce a successful model was:

Less than 1 year	18 percent of the 2,707 models
1 to 2 years	47 percent
2 to 3 years	21 percent
Over 3 years	14 percent

(Garetovskii, pp. 230-31)

Since 1967 (and particularly since 1969), profits of the R&D and design organizations are constituted from the following factors:

- Profits calculated into the original estimates on the basis of which a contract was signed with the branch ministry.
- Profits resulting from the difference between the estimated and actual costs of the work.
- Up to 1.5 percent of the national annual savings resulting from the new design,[200] so long as this does not exceed 6 percent of the original contracted price. The annual savings are first estimated by the ministry, and are later reevaluated after the assimilation of the new technology on the basis of the cost reductions realized by the user enterprise (for a process innovation) or of the price supplements allowed to the producer enterprise (for a product innovation). This portion of profit is paid as a royalty by the industrial enterprise which uses the innovation.

The one study which I have seen reported indicates, however, that the share of profits (above the standard amount included in the contractual price) which arises out of these payments for the economic effectiveness of the design constitutes only 25 percent of the total.[201] This low percentage is partly due to the way in which the national annual saving is calculated: it is based on the results of the first two years of application of the design in production, while the greatest economies are said to be reached only between the third and fifth years.[202]

Moreover, it is claimed by one Soviet author that R&D institutes are either totally unpaid, or at best poorly paid, for any cooperative work with production enterprises in the assimilation of their designs into production.[203]

Thus the prime incentive to R&D and design organizations is still that of cost economies in their own work rather than the quality of the final project. Furthermore, since national economies are calculated on the basis of the first two years of implementation of the design, there is financial incentive for them to develop a design which can be quickly assimilated into volume production rather than one which would be more complex but would have a more substantial eventual payoff to the economy.

This would appear to be a very perverse set of incentives, although probably better than the pre-1967 (1969) set. The whole treatment of national effectiveness is still considered as experimental;[204] one might guess that the difficulty in using the concept lies in the reasonable reluctance of Soviet authorities to lean too much weight on the ability of the Soviet system of relative prices to reflect properly the central authorities' utility function. But it is also dictated by the underlying Soviet philosophy of incentives, in general: that they should be paid out fully as quickly as possible after performance.

The emphasis on economic effectiveness in development and design took an additional form in June 1969, when the USSR State Committee of Prices decreed that no R&D or design organization could accept a product contract which did not include a "limit price." This limit price is the upper limit of the price for which the designed product could be sold without the user having supplemental net total costs through purchasing it rather than the product which it was to replace.[205] It was intended to provide at least a portion of the link between design and marketing which one finds in competent capitalist enterprises.

As of 1972, however, the limit-price system was still in the stage of theory.[206] In mid-1973, much work was said to be going on in the machine-building branch in assembling handbooks of limit prices for equipment which would be produced beginning only in 1976; there was no implication that many limit prices were yet available.[207]

IX THE SOVIET COMPARED WITH THE EAST GERMAN INCENTIVE MODEL

The underlying basis for Soviet difficulties in assimilating new product design into production, and in making major process changes in existing enterprises, has been postulated as consisting of the incentive system relevant to upper management of production enterprises. Sections VI and VII explored this system and its implications for technology assimilation. The difficulty did not appear to lie simply in the individual success indicators used, and thus it does not seem to be readily manipulable by cosmetic changes. It is the basic reward-punishment model which is at fault.

In looking to the future of Soviet absorption of technology, we must ask whether this model is inherent in a centralized socialist system. If so, extremely radical change of an ideological nature would be necessary before major improvement might be expected. Certainly this is the case for at least one major feature: the inability to offer major rewards to managers who successfully undertake major risks.

But a broader view of the model, and a contrast of it with what appears to be East German managerial experience, suggest that considerable modification might occur without violation of any currently held Soviet ideological shibboleths. Ideologically, the East German and Soviet patterns of managing industry do not differ in any significant respect. But they do appear to be based on quite different principles of management.

A. East German Success in Assimilating New Product Design

The fundamental assumption of this Section is that the German Democratic Republic has had considerably greater success than has the Soviet Union in putting new products into production. Throughout Eastern Europe,

the G.D.R. seems to be thought of by knowledgeable industrial managers and technicians as the CMEA (Comecon) country which performs best with regard to quality in general, and specifically with regard to technological assimilation.[208] Although the G.D.R. and Czechoslovakia are unique among East European countries in the overall quality of their industrial labor force, this fact alone does not seem to be the explanation. Such is particularly true because the professional staff and industrial management at all levels in the G.D.R. enjoy very little continuity with the pre-1946 period.[209] It is management, much more than the labor force as a whole, which is the critical factor in affecting the pace of technological assimilation.

No serious test of this Section's assumption can be made in this report. However, the available data as to the composition of foreign trade within the CMEA block of nations do provide support for it.

As a very small country in comparison with the USSR, and one which for political reasons has had to shift drastically away from its traditional suppliers and customers,[210] the G.D.R. has had little choice but to give great attention to issues of foreign trade. Since it has had relatively few raw materials and foodstuffs to export, it has had to strive to finance its imports primarily through the sale of manufactured goods. Moreover, it has had to do this essentially within the CMEA trading bloc; the G.D.R. is the CMEA country whose exports are most concentrated on sales to other members of the bloc (69 percent in 1970).

But the building of a substantial surplus of exports of manufactured goods within the bloc poses peculiar difficulties. Because of the bilateral trading system developed there, and the pricing system of intra-bloc trade which greatly favors manufactured goods, all of the CMEA countries are anxious to import foodstuffs and raw materials ("hard goods"), and to export manufactures ("soft goods"). As a result, each of the countries except the USSR attempts to attain a minimum of a balance of trade within the hard-goods category with each trading partner; in all probability, the USSR fails to follow such a policy only because of its political obligations to the other CMEA members.[211]

The G.D.R. leadership has tacked this problem by visualizing its role in intra-bloc trade as the providing of machinery which, in terms both of its modernity and quality, is unavailable from domestic or other CMEA sources. Although the G.D.R. shares with Czechoslovakia the position of the most developed of the socialist countries, it has differed considerably from Czechoslovakia in its emphasis upon the importance of developing new technology.[212] During at least the latter half of the 1960s, the East German central leadership seems to have been much more concerned with attaining such modernity than with achieving maximum rates of measured production growth.

Table 6 shows the degree to which the G.D.R. has succeeded in attaining the desired composition of intra-bloc trade. Over half of total East German exports both to the USSR and to the rest of the CMEA bloc consists of machinery and equipment. In 1968, imports of machinery and equipment from the USSR constituted only half of the G.D.R.'s exports of this category of goods to that country; such imports from Czechoslovakia and Poland--the most developed (with Hungary) of the remaining CMEA partners, and thus the ones least likely to engage in such a trading pattern--constituted only 60 percent of the G.D.R.'s exports of these products to them. Only in one regard was the G.D.R.'s composition of foreign trade similar to that of the other CMEA members: imports of machinery and equipment from Western Europe exceeded such exports to this region. Even here, the import surplus of these products was not overwhelming.

These data--particularly those of trade with the members of the CMEA bloc other than the USSR--suggest that the G.D.R. has been successful in persuading its bloc partners to regard its exports of machinery and equipment as fairly acceptable substitutes for those of the West, rather than as products in the same class as those of the other CMEA members. This result is a major support for our assumption as to the relative modernity of East German machinery and equipment.

Table 6

FOREIGN TRADE COMPOSITION OF THE G.D.R.

Trading Partners	Machinery and Equipment as Percentage of Total		Value of Machinery and Equipment Imports (Machinery and equipment exports = 100)	Products of the Machine building and Metalworking Industries as Percentage of Total	
	Exports	Imports		Exports	Imports
USSR	55.6[a]	15.3[b]	51.2[b]		
CMEA excluding USSR	59.5[a]	. . .	. . .		
Of this, Czechoslovakia and Poland combined	44.3[b]	32.5[b]	58.7[b]		
Industrialized capitalist countries	18.7[a]	. . .	. . .		
Of this, Western Europe	22.6[b]	32.8[b]	124.3[b]		
All countries					
1968				55.6	36.4
1969		32.6[c]			
1971	49.4			55.9	33.2

Notes: a. 1971

b. 1968

c. Data for 1968 are not available

Sources: Machinery and equipment, 1971: Staatliche Zentralverwaltung fur Statistik, Statistisches Jahrbuch 1973 der Deutschen Demokratischen Republik (East Berlin, Staatsverlag: 1973), p. 301

Machinery and equipment, 1968: P. Marer, Soviet and East European Foreign Trade, 1946-1969 (Bloomington, Indiana University Press: 1973), pp. 7, 90, 99, 114, 123, 227, and 235.

Machinery and equipment, 1969: Marer, p. 47

Allmachinebuilding and metalworking: Jahrbuch 1973, p. 288.

B. Comparison of the Two General Models

Managerial careers. In Section VI we provided data indicating that managerial career paths are badly clogged in Soviet industry. It was this phenomenon which provided the justification for our concentration on the I_i and I_j success indicators which affect managerial bonuses and the wage fund available for the enterprise's total labor force, and for our ignoring the I_k success indicators which affect only managerial careers (See Figure 2).

This approach, however, would be highly inappropriate for an analysis of the incentives facing enterprise managers in the G.D.R. Analysis of a small sample of upper managers suggests that career movement in East German industry is the most rapid in all of Eastern Europe; this analysis supports the impression derived from interviews.[213]

Table 7 shows the current age distribution in 1970 of a sample of top managers in enterprises, Kombinate, and VVBs.[214] In the enterprises and Kombinate, two-thirds of the top managers were less than forty years old, and only one-tenth were fifty or older. Furthermore--apparently quite unlike the situation in Soviet industry[215]--demotion is a serious threat for East German managers. Data are available as to the next post of fifteen predecessors of the top managers in the sample; 27 percent of them suffered clear demotion.

Table 7

AGE DISTRIBUTION OF EAST GERMAN TOP INDUSTRIAL MANAGERS, 1970

Age		VVBs	Top Managers in Kombinate and Enterprises
Less than 40 years	(percentage)	23	68
Over 49 years	(percentage)	8	9
Sample size	(number)	13	22

Note: The sample is drawn from the six organizations in which the writer conducted interviews. For each organization, data were provided for each top manager (although the proportion for whom age information is lacking is 24 percent in the VVBs and 21 percent in the Kombinate and enterprises). Top managers are defined as the chief executive officer and the four or five functional directors in each organization.

Bonuses. Thus the career aspect of managerial incentives would alone prevent top managers from concentrating on a few major success indicators, and would force them to strive for a more rounded definition of success as defined subjectively and ex post by their superiors. But the same is also true of managerial bonuses, the incentive category which occupies pride of place in our Soviet model.

Partly this is a function of the fact that the bulk of East German top-management bonuses are not paid out of the enterprise bonus fund at all, but rather are financed from a VVB or ministerial fund. Data are presented in Table 8 for the general directors of three of the major enterprises of one machinebuilding VVB. It should be noted that all three of these enterprises fulfilled their plans for the principal criterion (profits) to which the enterprise bonus fund was then attached, but all three also suffered deductions from the enterprise bonus fund which they would otherwise have earned through their accomplishments by this criterion.

These top-management bonuses, paid at the complete discretion of managerial superiors who are above the enterprise level, seem to have no counterpart in the Soviet system. The size of total top-management bonuses in East German industry is not determined by actual compared to planned performance of the enterprise according to a limited number of specified and weighted success indicators, as is the case in the Soviet Union; instead, it is determined completely subjectively. In this regard, it follows the practice for rewarding divisional managers which is customary in those American companies which have substantial managerial bonus schemes.[216]

The enterprise bonus fund in the G.D.R. is the source of virtually all bonuses for both manual and white-collar employees, with the exception of members of top management. Until 1972, the size of the enterprise or Kombinat bonus fund was in theory determined entirely by the amount of profits earned, subject to the side-conditions of fulfillment of two other

Table 8

BONUSES FROM ALL SOURCES OF ENTERPRISE GENERAL DIRECTORS IN THE G.D.R., 1969

(Percentage of one month's salary)

Source of Bonuses	1st Enterprise	2nd Enterprise	3rd Enterprise
Enterprise bonus fund:			
End-of-year bonus	67	54	
VVB bonus fund:			91
a. End-of-year bonus	83	91	
b. Sum of small bonuses paid throughout the year	67	91	0
Special bonus for developing and placing into production a new product line	333[a]	0	0
Total Bonus	550	236	91

Note: a. This was quite exceptional, and could be earned at most once every few years.

plan indicators. In fact, however, it was the degree of fulfillment of the side-conditions which served as the actual determinant of the bonus fund, and these side-conditions tended to be very broad. One enterprise in which the writer interviewed, for example, had as one of its side-conditions the fulfillment of all export contracts (including quality standards and delivery dates); its second side-condition was the fulfillment of the year's schedule of all measures planned to be taken to reduce costs.

The importance of these side-conditions is shown by the experience during 1969 of one VVB, which encompassed an entire subbranch of machine-building regarded as having been quite successful in that year. All enterprises of the VVB achieved at least 100 percent fulfillment of their planned net profits. However, deductions from the bonus fund earned according to the profit criterion were imposed upon all but a few of the smallest of the twenty or so enterprises. For one large enterprise for which exact data were given in an interview, these deductions constituted 14.3 percent of the bonus fund otherwise earned.

In early 1972, the system of side-conditions attached to payments into the bonus fund of the enterprise or Kombinat was abolished (up to the full extent of the planned bonus fund, although not above that level). At the same time, however, the guaranteed level of bonus payments per employee was raised sharply: to 80 percent of the planned bonus fund per employee in the unit. Between 1971 and 1972, the guaranteed bonus fund per employee in ministerially directed (as opposed to regionally administered) industry was increased from 200 marks to 585 marks annually; taken as a proportion of the maximum bonus fund (in most firms), the guaranteed minimum was now 65 percent instead of the previous 24 percent.[217] Thus the importance of the enterprise bonus fund as a source of variations in employees' incomes was downgraded seriously at the very moment that the system of side-conditions was weakened. The enterprise bonus fund had been transformed primarily into a source of delayed wage payments.

The contrast between this situation and that in Soviet industry today could not be sharper. In the USSR, enterprises which themselves earn sufficient profits in normal payments into their bonus funds to finance their bonuses are guaranteed 40 percent of the bonus fund planned for them for the year. Enterprises not earning sufficient profits have no guarantee whatsoever.[218]

To sum up, the incentives which matter most for East German top managers of enterprises (career incentives and their own bonuses from the VVB or branch ministry bonus fund) are not objectively linked to any small group of success indicators comparable to the I_i and I_j indicators in the Soviet model. The third important incentive (the size of the enterprise bonus fund) was only partially linked to a very specific indicator (profit) up until 1972, but was primarily determined by side-conditions which were often extremely broad. Since January 1972, the size of the enterprise bonus fund has been determined essentially by two quite specific indicators (profit and sales); while this represents a move in the direction of the Soviet model, it is overshadowed completely by the major reduction in the relative importance of the enterprise bonus fund as any sort of incentive. Only the fourth incentive treated earlier in Figure 2 (the size of the wage fund) is linked to a specific success indicator as in the case of the Soviet model.

Tautness of plans. An important feature of our "fuller model of managerial behavior" in Section VI was that Soviet enterprises are faced with taut (ambitious) plans which they cannot realize 100 percent except by violating the I_k success indicators to which bonuses are not specifically attached. Such general tautness of Soviet planning is an important assumption of our general Soviet model.

Unfortunately, it is not an assumption which can be tested with recent data. The only general data that bear on the subject are for all of Soviet industry during the years 1951-54, when in each year between 31 and 40 percent of all industrial enterprises failed to fulfill their most important

annual plan indicator (production).[219] More recent Soviet discussions suggest that the assumption is still valid.

The situation in East Germany appears to be radically different. Certainly there was no taut planning during 1969 or 1970 for the enterprises and Kombinate in which the writer interviewed in 1970, at least as regards the success indicators which were defined by the plan as "key."[220] During 1972, only 5 percent of the industrial enterprises under ministerial rather than regional jurisdiction failed to fulfill their annual sales plans--which by that time was the most important success indicator for the enterprise; the comparable figure in 1973 was 2 percent.[221] It is true that recent profit plans may be set more harshly; during the first half of 1973, one-third of these enterprises failed to meet their plans for cost reduction[222] and, presumably, many or most of them did not reach their profit plans. But by 1973, profit-plan targets were almost certainly considered less important than sales targets; profit-plan underfulfillment presumably reflected heavily the recent emphasis upon determining product mix according to "need" rather than profitability.

Plan overfulfillment. Despite the fact that only 2 percent of East German industrial enterprises failed to fulfill their sales plans in 1973, overfulfillment by all enterprises under ministerial jurisdiction averaged only about 0.8 percent.[223] These data are quite in line with 1968 and 1969 figures for the organizations in which the writer interviewed and for all the enterprises of one subbranch of industry.[224]

It is hard to see how the interfirm variation in plan fulfillment could be as small as these figures imply unless overfulfillment was purposely held back by the firm managements. In fact, interview materials show precisely this. Managements in one enterprise, two Kombinate, and one VVB described this as a matter of conscious managerial policy: their goal was not overfulfillment of the major success indicators, but rather simple plan fulfillment with the use of reserve resources for meeting what have been labeled earlier as the I_k indicators.[225]

Such concentration on I_k success indicators is not a peculiarity of East German management. Similar attitudes and results are found in at least some large, decentralized American corporations, where divisional managements display the same reluctance to exceed their annual budgets of profit or profit percentages. Like the East German enterprises, such divisions place their supplemental resources into improving performance as judged by somewhat nebulous criteria, rather than in overfulfilling their basic divisional plans.[226] But such emphasis on I_k success indicators is very different from the behavior observed in Soviet enterprises.

General characterization of the models. As a managerial model, the East German one appears quite similar to what the writer has observed in a number of large, decentralized American companies in which he has interviewed. In fact, managerial behavior in East German industry is more similar to that observed in these American companies than either is to behavior of management in Soviet enterprises or within large industrial British or French companies. The American-GDR model (as it will be called) can be characterized as a particular form of satisficing, in contrast to the Soviet managerial model which is based on maximizing.[227]

The Soviet general model is a conventional economist's one of maximization under constraints.[228] Individual enterprise managements are rewarded for maximizing one or another specified combination of a few quantitative objectives (I_i success indicators), subject to the constraint of meeting both a few individual quantified objectives (I_j indicators) and a combination of other central objectives (I_k indicators) of which only some are quantified. Most of the specified constraints (the I_k indicators) tend in fact to have little force and are non-binding.

American corporate planning for the divisions and lower units within the organization, and East German planning for the enterprises and Kombinate, single out a small number of critical plan objectives (e.g. in the American case, profits earned during the planning year). In sharp contrast to the Soviet model, however, there is no substantive incentive

given for overfulfillment of these objectives. Rather, the plan targets serve as constraints which are to be met 100 percent but no more, and it is trusted that the residual managerial efforts will be directed to meeting the residual and often only informally specified goals of the central planners of the company or industry (in the two countries respectively). Managers of American corporate subunits, and of East German enterprises and Kombinate, "satisfice" with regard to meeting their stated plan objectives--i.e., they make no efforts to exceed them.

The satisficing model can differ significantly from the maximizing model only if the critical plan objectives are set at less than a taut level. This constraint was realized both in the American corporations and in the East German enterprises in which the writer has interviewed. Furthermore, if the satisficing model is to operate, managerial reward cannot be attached to the degree of success in overfulfilling plan indicators. In both the American corporations and in East German industry, career incentives are of prime importance, and these are almost necessarily subjective.[229] In addition, managerial bonuses are determined on essentially subjective grounds.

The approach of higher authorities toward managerial incentives is radically different in the American-G.D.R. model than in the Soviet one. As described in Section VI, Soviet authorities view the managerial-incentive problem as fundamentally that of motivating high effort. They take the stand that such effort is best motivated if the relevant accomplishments are clearly and objectively defined, are short term in nature, and if the financial rewards are linked in a simple and predetermined fashion to these accomplishments.

East German central authorities, and American corporate central decisionmakers, take a different view of the managerial-incentive problem. Both groups seem to take for granted a high level of managerial effort. The incentive problem to which they direct their attention is that of motivating managers to take the "proper" decisions and to lay the "correct" amount of relative stress on different criteria at different times. Both

groups appear to feel that a heavy stress on fulfillment of quantitative success criteria, which are set at ambitious levels, will defeat this objective. Thus both link managerial rewards to subjective evaluation of performance, rather than to reliance on objective criteria which have been given a predetermined weight in the evaluation system.

Post-1970 changes in the G.D.R.'s system of industrial planning seem to reflect some shift back to a more centralized system of the Soviet type. But the East German managerial-incentive system appears to continue to be based on distinctly non-Soviet principles.[230]

C. East German Traits Specifically Related to the Assimilation of New Technology

An explanation for the apparent difference in the degree of success of East German and Soviet enterprises in assimilating new-product technology must rest upon the comparison of their general incentive models. Operating within a satisficing-model framework, East German managers of enterprises and Kombinate are able to give a degree of emphasis to new-product development and assimilation into production which cannot be expected from their Soviet counterparts. The G.D.R.'s foreign-trade position provides its leaders with a particularly strong motive for encouraging such emphasis.

Discussion below of specific traits relevant to new-product development and assimilation is founded on a rather flimsy data basis. This subject was not a focus of interest in the interviews conducted by the writer when in the G.D.R., and the East German literature on this subject is barren and uninformative compared to the Soviet. But the thrust of the argument throughout this report has been that Soviet difficulties in the assimilation of new technology arise primarily out of their general incentive model, rather than from specific incentive or organizational measures. Thus the weakness of this subsection is not of critical importance.

Organizational aspects. Especially since 1968, Kombinate have been widely formed in East German industry. At least 130 of them existed in industry and construction by 1970.[231] Most have been subordinated to the VVBs of their respective subbranches, but an increasing number (43 by early 1973) reported directly to their branch ministry.[232] The Kombinat organizational form has been particularly important in heavy industry, including the machinebuilding sector.

While an unknown proportion of the Kombinate have been associations of enterprises which retain much of their former managerial independence, the strong tendency has been to reduce the former production enterprises to the status of purely production units, and to make the Kombinat rather than its component enterprises the basic managerial unit of industry. By 1970, the Kombinate which the writer visited had been transformed much farther in this direction than have the Soviet ob''edineniia even today. The extension and transformation of the Soviet Union's ob''edineniia, seemingly planned for 1976 or even later,[233] is intended to replicate what has already been accomplished in the G.D.R.

The significance for our purposes of the development of Kombinate is that one of their stated prime functions is to coordinate within a single organization the various stages of product and process development, design, and assimilation of the new technology. As of 1973 in the Soviet Union, even many of the best known scientific-production ob''edineniia had failed to achieve such coordination, since their R&D and design institutes and bureaus remained in reality independent organizations.[234] In East German contract law, on the other hand, the R&D center of a Kombinat is treated as a component part of the Kombinat central administration, and has no authority to sign legally binding contracts.[235] Although there is no information as to how well the various Kombinate in fact integrate within their own organization the R&D-design-production process, it would appear that they go considerably further in this regard than do even the scientific-production ob''edineniia in the Soviet Union.

This is not to suggest that research and development in the G.D.R. is not also done in ministerial R&D institutes, as well as in institutes of the Academy of Science and in higher educational institutions. But development and design appear to be organizationally coordinated with production more in the fashion used by large capitalist firms than in that employed within the Soviet Union.

Use of temporary assignments. Where applied research is done in the Academy of Science and higher educational institutions, East German administrators and writers place considerable stress on the importance of seconding staff through shortrun assignments both to and from enterprises and Kombinate.[236] Transmission of information through personal contact seems to be given greater stress in the G.D.R. than in the Soviet Union.

This policy of temporary assignments is quite in line with the system used for on-the-job training of upper managerial personnel, where a man designated for a ministerial department headship might be given several years' prior managerial experience in enterprises and Kombinate as a specific training device.[237] Linkage of organizational activities through temporary interchange of personnel is a policy consciously followed in East German industry as a whole; use of this system for coordinating R&D and production units is simply an application of the broader policy. There are no indications that such a general policy is applied in Soviet industry.

Encouragement of development and assimilation of new technology in enterprises and Kombinate. Here there seem to be only two specific techniques which are totally absent or substantially less used in Soviet industry. Neither is likely to be of major importance.

The first is the payment of license fees for the use by East German enterprises of technology either developed by other East German enterprises or financed by them through contracts with R&D institutions. In the Soviet Union, such interenterprise exchange of technology is done

at the cost of transmission only.[238] In the G.D.R., such license fees can pay not only the cost of transmission, but also the cost of originally developing the technology as well as additional bonus funds.[239]

The second is the far broader scope of the East German than of the Soviet fund for the assimilation of new technology. In both countries, this fund finances some of the expenses of technological assimilation out of ministerially allocated moneys, and use of these moneys is not charged against present or future enterprise profits. In the Soviet Union, however, in a number of branches of industry, this fund is, as a rule, sufficient to finance costs of assimilation only until the first industrial batch of the new product has been produced.[240] As we have seen, this is usually well before the product's production becomes profitable. In the G.D.R., the fund is designed to cover costs until the point where production costs have been brought down to the level of planned unit costs for the product.[241] However, there is no firm information as to whether, in practice, a larger proportion of assimilation costs of new technology are borne out of the fund in the G.D.R. than in the USSR.

Other specific devices for encouraging development and assimilation of new technology seem rather similar to those used in the Soviet Union, and the difficulties with them are also similar. For example, East German prices of new products have in certain cases included an allowance for a share of the economic savings to the user to go to the producing enterprise. But this pricing policy has not been highly successful, as is shown by the fact that its scope was sharply reduced by 1973.[242] The same limited success appears to have been met in applying the East German system of gradually declining prices, which was developed considerably before the Soviet system. The G.D.R. system of encouraging research in special R&D institutes was described in 1973 by two East German authors as basically similar to the system applied in the Soviet Union.[243]

What seems to be the greatest difference between the East German and Soviet experience with specific incentive devices for the development and assimilation of new technology is that, in sharp contrast to the Russians,

the East Germans appear to place little hope in such devices as a means of ameliorating problems. This is shown most clearly by the rather slight attention given to them in the East German literature. It is also stated explicitly by one East German economist that no great results can be anticipated from such devices--a type of statement which has not been encountered in the corresponding Soviet literature.[244] It would appear that the East Germans have quite properly placed more confidence in the overall incentive pattern used in the economy as a whole--as this pattern is represented in the American-G.D.R. general incentive model.

X POSSIBILITIES OF IMPROVEMENT IN SOVIET ASSIMILATION OF NEW TECHNOLOGY

A. Incentives

In this report, we have taken the position that the essence of the Soviet problem of incorporating new-product development and major new-process development into normal civilian production consists of incentive difficulties.

Two of these difficulties seem inherent in a centralized planning system of the Soviet variety, unless there are major ideological and institutional changes which seem quite unlikely to occur during the medium-term future.

The first difficulty consists of the sellers' market which exists for the vast majority of products.[245] Given a general sellers' market, enterprises are not compelled by the pressure of market forces to engage in new product innovation. The absence of competition shields them from what is perhaps the main force leading to product innovation in developed capitalist countries.

The second difficulty is the absence of really major reward for successful risk takers among enterprise managers. The unavailability for managers of any equity ownership in their own enterprises removes the stimulus for taking significant risks of the sort often involved in major product and process innovation. The combination of these two factors eliminates both the stick and the carrot which together play the primary role in such innovation in capitalist economies. No significant change should be expected in this unfortunate combination.

A second type of obstacle to successful assimilation of new technology lies in what has been labelled as the general Soviet incentive model. The German Democratic Republic has shown that this model is not inherent in a Soviet-type planning system, but is rather a peculiarity of the Soviet Union's own management system. The basic difference between the Soviet and East German general models of managerial incentives is that, in the first, managerial rewards and punishments are linked essentially to a limited number of objective, quantitative success indicators whose relative weights have been determined ahead of time; in the second model, evaluation of enterprise managements is carried out quite flexibly through the use of subjective criteria.

Clearly the Soviet Union could shift to the G.D.R.'s managerial-incentive system without any violation of its ideological principles. The data of Table 9 suggest that some sacrifice in the rate of growth of overall production might be involved, but so many other causal factors exist for explaining the fairly small difference in national per capita growth rates that we can draw no conclusions.

What would be involved in such a shift is a basic change in Soviet managerial philosophy. While such philosophy has nothing to do with Soviet ideology, and perhaps even has little significance for basic power relations within the Soviet middle or upper leadership ranks, it may be nonetheless resistant to change. In fact one might even argue that the current managerial philosophy--based as it must be on concepts both of "fairness" and of incentives which today are widely held among Soviet managers--may be at least as resistant to change in the short run or even medium term as is ideological philosophy.

Furthermore, there is nothing in either the Soviet or East German literature to indicate recognition in either country that the managerial incentive systems of the two nations are fundamentally different. One would not expect such a recognition to develop overnight.

Table 9

RATES OF MACRO-ECONOMIC GROWTH IN THE USSR AND IN THE G.D.R.

Year	Indices: National Income Produced per Capita		Indices: Labor Productivity in Industry[a]	
	USSR	G.D.R.	USSR	G.D.R.
1965 (1960=100)	120	120	126	127
1970 (1965=100)	139	128	139	130
1972 (1970=100)	108	110	111	108

Note: Data are taken from a single CMEA source so as to provide the greatest degree of comparability. Since our interest is only in the relative rates of growth in each country, no attempts at adjustment have been made.

a. This is calculated from national income produced in industry, divided by the total personnel engaged in industrial activities within industry. Personnel in industrial enterprises of collective farms, and personnel of small auxiliary industrial shops are excluded from the labor force as defined here.

Source: Rough calculations from Sovet Ekonomicheskoi Vzaimopomoshchi, Statisticheskii Ezhegodnik 1973 (Moscow: 1973), pp. 45, 47 and 501-02.

Nevertheless, it would appear that major improvement in Soviet assimilation of new technology could be achieved if Soviet industry were to adopt the American-G.D.R. model. With the major current interest in management techniques which exists in the USSR, one should not write off the possibility that interest in techniques may broaden to interest in philosophy.

A third type of obstacle to successful technological assimilation consists of specific forms of success indicators, cost-sharing and pricing devices, and temporal range of plans against which enterprise results are evaluated. It would seem to be a very safe prediction that these will continue to be modified.

It appears to the writer that such cosmetic changes in the managerial-incentive model will not have any very major effect for good or for bad. As applied to the G.D.R., this would appear to be the East German view. F. M. Scherer's treatment of different forms of incentive systems for U.S. Government contractors in the development and production of weapons suggests that such differences are not of great significance. The long Soviet experience in making such changes is also not promising as to effect.

B. Organization

The 1974 decree concerning the future reorganization of the ob''edineniia--transforming them into genuinely unitary organizations--offers the promise of bringing the Soviet organizational relationship between advanced development, design, and production into line with the pattern dominant in the West and, perhaps, also in the G.D.R. Certainly, if this transformation is realized, it will provide significant gross advantages for the technological assimilation process.

Whether the net advantage will be substantial, or even positive, is much more debatable. Given the current incentive pattern which leads ob''edinenie top management to emphasize short-run results, the effect of such a change might even be to cripple temporarily the Soviet development

effort. To this writer, the Soviet hesitancy to move radically in this direction is fully justified.

C. Absorption of Foreign Technology

It seems reasonable, given the current international period of detente, to predict continued increase in the absorption of foreign technology in the Soviet Union. But one might also predict a low benefit-cost ratio in such absorption. So long as Soviet leaders remain unwilling to accept equity investment and/or massive two-way flows of technologists, foreign technology will continue to be absorbed in an inefficient fashion. International experience suggests that such absorption cannot be both rapid and efficient without the movement of people. The importing of products, blueprints, and turn-key production facilities does not seem to be an effective substitute. Yet it is this type of substitute on which the Soviet Union is currently relying. However, there are indications of growing Soviet interest in developing alternative arrangements for industrial cooperation with foreign firms which will serve as more adequate substitutes for outright foreign equity investment in the Soviet Union.

D. Proportional Inputs in Different Forms of R&D

A reduction in the current disproportion among different stages in the R&D chain--which exists both in respect to the West and to the ideal of all Soviet writers on the subject--seems to be the change which is the most likely to occur. This would be in the direction of a reversal of the current proportions of expenditures on applied research as compared with engineering and design. Such an improvement in the relative sizes of the different links in the process might substantially increase the effectiveness of the Soviet R&D effort, but only insofar as this is embodied in final-product and process design and in experimental models. It is irrelevant to the problems of assimilation of such design into actual production.

It is difficult to see why improvement should not occur in regard to this issue of proportionality of effort. The problem is fully recognized; the solution (redirection of manpower and other inputs) seems simple to

carry out, at least gradually, in a period when total R&D inputs are still growing at a fairly rapid pace. No overwhelming obstacles of an ideological, philosophical or institutional nature are apparent.

Yet even here, predictions of rapid improvement might be hasty. For the disproportionality problem in Soviet R&D is one of long standing and one which has shown no secular improvement. Perhaps there exist fundamental reasons in Soviet philosophy as to science, or in Soviet institutions, which lead to the maintenance of disproportionality. This is a question, however, which transcends the subject of this report.

Appendix A
FOOTNOTES

Appendix A

FOOTNOTES

1. R. Amann, M. J. Berry and R. W. Davies, "Science and Industry in the USSR," in Organization for Economic Co-operation and Development, Science Policy in the USSR (Paris: 1969), p. 382. Appendix B provides the main basis for this statement.

2. D. M. Palterovich, Park Proizvodstvennogo Oborudovaniia (Moscow, Nauka: 1970), p. 113.

3. I. M. Denisenko in A. S. Tokachev and I. M. Denisenko, Osnovnye Napravleniia Nauchno-Tekhnicheskogo Progressa (Moscow, Ekonomika: 1971), pp. 82-83. Comparisons are restricted to the United States, West Germany, France, Japan, the United Kingdom, and Italy.

4. Ibid., p. 6.

5. Ibid., p. 130.

6. D. Palterovich in Voprosy Ekonomiki, 1970, 2, p. 71.

7. Palterovich, Park Proizvodstvennogo Oborudovaniia, p. 176.

8. Calculated from O. V. Astrov in Tokachev and Denisenko, p. 145. Nonwoven fabric was first introduced into production in the United States in 1948, and tufted nonwoven fabric for carpeting was introduced in 1952 (J. Kornai, Anti-Equilibrium, Amsterdam and London, North Holland: 1971, pp. 266-67).

9. O. Volkov in Voprosy Ekonomiki, 1972, 3, p. 117. In contrast, the American proportion rose from 32 percent in 1965 to 47 percent in 1971.

10. Ekonomika i Organizatsiia promyshlennogo proizvodstva, 1971, 4, pp. 85-112, as summarized in ABSEES, April 1972, pp. 94-95.

11. Calculated from K. I. Klimenko and E. V. Petrova, Ekonomicheskaia Effektivnost' Tekhnicheskogo Progressa v Tiazheloi Promyshlennosti SSSR (Moscow, Nauka: 1971), p. 224.

12. Ibid., pp. 215-16.

13. Palterovich, Park Proizvodstvennogo Oborudovaniia, pp. 94-95. For background as to this development, see R. Campbell, The Economics of Soviet Oil and Gas (Baltimore, Johns Hopkins Press: 1968), pp. 87-120.

14. Counter examples can be cited. During the 1960s, while the proportion of automatic and semiautomatic equipment in the total stock of welding equipment was rising in both the Soviet Union and the United States, the absolute proportions were higher in the Soviet Union (Palterovich, Park Proizvodstvennogo Oborudovaniia, p. 175). Soviet comparisons of native and foreign models of analogous metalcutting machine tools are said to show that most Soviet designs in this industry are as good as the best foreign models (ibid., p. 309). About 1970, the Soviet Union had 10 million tons of capacity for uninterrupted steel casting--compared to one million tons capacity in Great Britain (I. M. Denisenko in Tokachev and Denisenko, p. 95). Soviet blooming mills for steel production, and hydroturbines and their generators, are said to be superior products by the standards of leading industrial countries (IAsnovskii, Makarov, Fomichev, and Kolbiagin in ibid., p. 127). Between 1960 and 1969, the proportion of the USSR's steel which was smelted with the application of oxygen increased from 28 to 60 percent (Klimenko and Petrova, pp. 29-30). Between 1960 and 1970, gas and oil as a percentage of total fuel consumption increased from 38 to 59 percent (Volkov, p. 113). It was calculated that in 1970 the Ministry of Instrument-Making, Automation, and Control Systems produced 60 percent of its total value of production according to standards which were at the level of the leading achievements of native and foreign technology (K. Rudnev in Planovoe KHoziaistvo, 1973, 1, p. 8).

15. E. V. Kosov and G. KH. Popov, Upravlenie Mezhotraslevymi Nauchno-Tekhnicheskimi Programmami (Moscow, Ekonomika: 1972), p. 19.

16. A. Kuznetsov and A. Koshuta in Voprosy Ekonomiki, 1971, 5, p. 72. Data of the USSR Central Statistical Office for 1966 are said to show that half of the current products of the machinebuilding branches had been assimilated into production during the previous five years, and over one-third during the last three years; however, these figures appear to relate to assimilation into the production program of a given enterprise, irrespective of whether the product was previously produced elsewhere in the Soviet Union (IA. Kvasha in Voprosy Ekonomiki, 1969, 3, p. 30).

17. Kuznetsov and Koshuta in Voprosy Ekonomiki, 1971, 5, p. 71. These data refer to the items which were listed on the price lists of July 1967, but not on those of July 1970.

18. IU. Muntian in Planovoe KHoziaistvo, 1973, 7, p. 36.

19. Palterovich in Voprosy Ekonomiki, 1970, 2, p. 72.

20. I. Denisenko in Planovoe KHoziaistvo, 1971, 9, p. 60.

21. K. I. Klimenko, Ekonomicheskie Problemy Tekhnicheskogo Progressa v Mashinostroenii SSSR (Moscow, Nauka: 1965), pp. 98-122. This is for a specified ball bearing produced, both on an automatic and non-automatic line, in Shop 1 of the Moscow First Ball-Bearing Plant. The cost data show that, even if the cost estimates of the original design of the line had been realized, the line would have been an economic failure.

	Total Costs per Unit (in rubles)[a]		Annual Production Volume (000 units)
	On the Automatic Line	In Non-automatic Production	
Actual in 1954[b]		1,220	600
Expected cost (at full mastery of production) according to the original design of the line	1.276		600
	1.234		700
Actual in 1962 (6th year of operation of the automatic line)	1.608		655
		1.401	...

[a] Costs include amortization of equipment, but exclude any return on capital.

[b] Presumably, this was the year when the automatic line was designed.

22. Palterovich, Park Proizvodstvennogo Oborudovaniia, pp. 304-05. Palterovich finds this result supported by data as to the average weight of metalcutting equipment produced in the Soviet Union compared to three capitalist countries; he claims that the weight differences are not explained by weight differences for analogous machine tools, but rather by the national mixes of machine tools produced (ibid., pp. 309-10). Data from a 1960 study by the Russian Republic's Central Statistical Office of plants with 104,000 metalcutting machine tools do not suggest that Palterovich's results are due to Soviet machine tools being idle an exceptionally high proportion of a working shift (see Klimenko, p. 131).

The difficulty which Soviet factories have in arranging subcontracting is doubtless one legitimate reason for their desiring equipment which is heavier and has greater capacity than that normally needed. But in view of the large size of individual Soviet factories by international standards, this legitimate reason can probably explain only a small part of the observed result.

23. One Soviet author has indicated another incentive reason for minor product innovations in the machinery field. If price increases on a product are "needed" by an enterprise, they will be approved only if they are accompanied by some design change which will permit the reclassification of the item as a new product (Palterovich, Park Proizvodstvennogo Oborudovaniia, p. 188). It is not possible to evaluate the quantitative significance of this motive for "new product" introduction.

24. See D. Granick, Soviet Metal-Fabricating and Economic Development (Madison, University of Wisconsin Press: 1967), pp. 237-38, and Granick, "The Soviet Research and Development System," Minerva, IX, 1 (1971), pp. 129-30. For the opposite viewpoint, see J. Berliner, "Managerial Incentives and Decisionmaking: A Comparison of the United States and the Soviet Union," in Subcommittee on Economic Statistics, Joint Economic Committee, Congress of the United States, Comparisons of the United States and Soviet Economies (Washington, D.C., Government Printing Office: 1959), Part I, pp. 364-65; also, R. Amann, "The Soviet Research and Development System," Minerva, VIII, 2 (1970), pp. 217-41.

25. K. Rudnev in Planovoe KHoziaistvo, 1973, 1, p. 8.

26. For such a complaint with regard to the Soviet machinebuilding industries, see V. Zaitsev in Voprosy Ekonomiki, 1973, 11, p. 95. Zaitsev says that, on the average, manufacturing startup costs for producing a single new piece of equipment or apparatus are 30,000 to 60,000 rubles in the machinebuilding ministries other than those of heavy, energy, and transport machinery, and that they are still greater there.

27. For such a statement concerning Soviet proportions, see V. S. Sominskii in P. N. Zavlin, A. I. SHCHerbakov, and M. A. IUdelevich, Trud v Sfere Nauke (Moscow, Ekonomika: 1973), pp. 4-5.

28. R. S. Morse, "The Innovative Environment," in European Industrial Research Management Association, Conference Papers, IV (Lund: 1967), pp. 45-50. Morse is here reporting on the results of a study analyzed in the U.S. Department of Commerce report, Technological Innovation: Its Environment and Management (Washington, D.C., U.S. Government Printing Office: 1967).

29. J. B. Kvasha in Wirtschaftswissenschaft, 1971, 9, pp. 1344-45.

30. E. Zaleski, "Central Planning of Research and Development in the Soviet Union," in OECD, Science Policy in the USSR, p. 92. See Zaleski's entire article for an admirable discussion of such planning.

31. M. A. Vilenskii in L. M. Gatovskii, Planirovanie i Stimulirovanie Nauchno-Tekhnicheskogo Progressa (Moscow, Ekonomika: 1972), p. 91.

32. G. KHachatrian and A. Mkhitarian in Planovoe KHoziaistvo, 1973, 8, p. 38. Since the base of such "work on technical progress" is not defined, the percentages should be taken as indicating only an impression of a small proportion.

33. V. Trapeznikov in Izvestiia, 18 January 1970, pp. 1 and 3, summarized in Current Digest of the Soviet Press, XXII (1970), 3, p. 8.

34. L. M. Gatovskii Ekonomicheskie Problemy Nauchno-Tekhnicheskogo Progressa (Moscow, Nauka: 1971), p. 145. The same figures are cited in Kosov and Popov, p. 22, with no differentiation being made between the classifications of expenditures used in the three countries; this suggests that the American and British classifications used may not be substantially different from the Russian. For a discussion of the terminology used, see Zavlin et al., pp. 20-27.

The British scholar R. Amann cites rather similar (but undated) figures for the USSR and the United States; the Soviet figures are Amann's own estimates, while the American percentages are taken from Pravda, 31 March 1971 (La Recherche, 29, 1972, pp. 1029-30).

The only citation of sources, however, is that the American percentage is for "development" as shown in the results of the International Statistical Year for Research and Development (Amann, Berry, and Davies in OECD, Science Policy in the USSR, p. 390).

L. E. Nolting points out that the above Soviet-American comparison is an exaggeration. Assuming that the Soviet data represent a breakdown of expenditures on "science" (the Soviet source is ambiguous as to this), he notes that such Soviet expenditures do not include the production and testing of industrial prototypes in factories under production conditions (although they do include such expenditures when made in R&D and design institutes); the American figures, on the other hand, do include all such production and testing of industrial prototypes. Nevertheless, Nolting agrees that the Soviet disproportion problem is severe. (L. E. Nolting, Sources of Financing the Stages of the Research, Development, and Innovation Cycle in the USSR, U.S. Department of Commerce, Bureau of Economic Analysis, Foreign Economic Reports, 3, September 1973, pp. 1, 2, and 15.)

35. N. V. Garetovskii, Finansovye Metody Stimulirovaniia Itensifikatsii Proizvodstva (Moscow, Finansy: 1972), pp. 230-31. What appears to be a similar study is referred to by G. Glagoleva in Voprosy Ekonomiki, 1973, 2, p. 16.

36. B. F. Zaitsev and B. A. Lapin, Organizatsiia Planirovaniia Nauchno-Tekhnicheskogo Progressa (Moscow, Ekonomika: 1970), p. 15. No sources are cited, but the authors work in the State Committee for Science and Technology. Their data are accepted by A. I. Uvarova in Nauchnyi Progress i Razrabotka Tekhnicheskikh Sredstv (Moscow, Nauka: 1973), p. 236; Kosov and Popov, p. 101, use similar data.

The total number of "scientific personnel" in these institutions given by the source in the same table is the identical figure to that cited in the official statistics. "Scientific personnel" are defined as professionals carrying out research or development work in the system of the various academies, in other research and development institutes, or in production enterprises, as well as those doing teaching and/or research in the higher educational institutions. Almost all have higher education. One-third of this total were employed in higher educational institutions. (Narodnoe KHoziaistvo SSSR v 1972 g., p. 766, and Amann, Berry, and Davies in OECD, Science Policy in the USSR, p. 543.)

If we wished to exclude those employed in higher educational institutions from the total base of personnel covered, the percentages cited in the text would probably fall even more sharply between 1960 and 1968. This is because the proportion of all scientific personnel who worked in higher educational institutions fell from 41 percent in 1960 to 33 percent in 1965, and then rose again to only 36 percent in the early 1970s. (These percentages are calculated from H. Wienert, "The Organisation and Planning of Research in the Higher Educational Establishments," in OECD, Science Policy in the USSR, p. 313 and Narodnoe KHoziaistvo SSSR v 1972 g., p. 129. The 1970s percentage is taken from S. Mikulinskii in Kommunist, 1973, 5, p. 579.)

37. Uvarova, p. 237.

38. G. Glagolova in Voprosy Ekonomiki, 1973, 2, p. 17.

39. Zaitsev and Lapin, p. 15.

40. A. TSygichko in Voprosy Ekonomiki, 1972, 10, pp. 30-34.

41. Palterovich, Park Proizvodstvennogo Oborudovaniia, pp. 155-57. Palterovich, as well as others, writes that the design and construction of these large plants is normed to take four and one-half to seven years, and that almost ten years expire before they are operating properly.

Within the machinebuilding sector, the current size of firm (which is normally synonymous with an individual factory) is shown by the following table:

PROPORTION OF ALL PERSONNEL WORKING IN THE SUBBRANCH WHO ARE EMPLOYED IN FIRMS ABOVE THE FOLLOWING SIZE

Subbranch of Machinebuilding	5,000 or More Employees (Percent)	10,000 or More Employees (Percent)
Automobile industry	78	61
Tractor industry	68	64
Agricultural equipment industry	60	29
Metallurgical equipment	92	74
Turbine industry	80	20
Cranes, hoists, and internal transport equipment industry	33	0
Machine tool industry	13	0

(IU. K. Kozlov, Organizatsionnye Problemy Nauchno-Technicheskogo Progressa, Moscow, Mysl': 1972. The table was worked out by the author, and is for an undated period which is described as current.)

42. See the complaint of O. Lacis in Novyi Mir, April 1967, as reprinted in The Current Digest of the Soviet Press, XIX, 29 (1967), especially pp. 15-17.

43. A. V. Bachurin in L. M. Gatovskii, Planirovanie i Stimulirovanie Progressa, p. 161.

44. Palterovich, Park Proizvodstvennogo Oborudovaniia, p. 212. Data presented by the same author in an article published at much the same time gives a counterimpression for the machinebuilding and metalworking industry; they show a sharp reduction between 1963 and 1967 in the scrapping of this industry's equipment taken as a proportion of the equipment installed in the individual year which corresponds to the precise normed average period of life of equipment in this industry. However, since the data relate to installations during the immediate postwar years, use of an average-length-of-life figure only one to three years longer than the norm used would totally eliminate this trend. (D. Palterovich in Voprosy Ekonomiki, 1970, 2, pp. 62-66.)

45. Palterovich, Park Proizvodstvennogo Oborudovaniia, p. 187, and M. V. Gazaliev, I. A. Kushnikova, and T. P. Nikonova in Tokachev and Denisenko, pp. 60-61.

46. W. J. Arrol (Director of Group Research of Joseph Lucas Ltd.), "The Technology Gap between the United States and Europe," in European Industrial Research Management Association, Conference Papers, IV (Lund: 1967), p. 76.

47. H. R. Mathys, vice-chairman of Courtaulds Ltd., in ibid., VII (Paris: 1969), p. 73.

48. A. S. Tolkachev and I. M. Denisenko, in Tolkachev and Denisenko, p. 15. Presumably, this extensive use of licensing by Japanese industry was possible only because of the severe restraints placed upon foreign equity finance; but the same restraints, in even a stronger form, apply in the Soviet Union.

49. Gesetzblatt der Deutschen Demokratischen Republik, Part II, 1973, 10 pp. 109-16.

50. It should be noted that access by one Soviet enterprise to technology developed by another still seems to be granted at the cost of transmission (V. Dozortsev in Planovoe KHoziaistvo, 1973, 7, p. 121). I have seen no indications of a projected change paralleling that which has occurred for transfer among CMEA countries.

51. U.S. National Science Foundation, Funds for Research and Development in Industry: 1959 (Washington, D.C., U.S. Government Printing Office: 1962), p. 14, as referred to in F. M. Scherer, The Weapons Acquisition Process: Economic Incentives (Boston, Graduate School of Business Administration of Harvard University: 1964), p. 372.

52. Scherer, pp. 168-70.

53. Scherer's book is to a large degree devoted to this last problem. He sees it as a likely reason for why so little company-sponsored R&D in the United States is contracted to outside organizations (ibid., p. 372).

54. C. Kaysen, "Improving the Efficiency of Military Research and Development," Public Policy, 12, as referred to in Scherer, pp. 390-91.

55. See D. W. Collier (vice president for research in Borg-Warner), "Programming Research in a Decentralized Multi-Divisional Company," in European Industrial Research Management Association, Conference Papers, II (Monte Carlo: 1965), pp. 31-46.

56. This was the Borg-Warner approach (ibid., pp. 36-38). Despite the considerable centralization of R&D activities in this company under the corporate research director rather than under the divisions, 85 percent of total expenditures on R&D and on the engineering of new products, new applications, and new production processes were still borne by the divisions.

57. F. H. Goldner and R. R. Ritti, "Professionalization as Career Immobility," American Journal of Sociology, 72, 5 (1967), pp. 489-502.

58. N. D. Tiamshanskii, Ekonomika i Organizatsiia Nauchno-Issledovatel'skikh Rabot v Mashinostroenii (Leningrad, Mashinostroenie: 1967), p. 21.

59. TsSU SSSR, Narodnoe KHoziaistvo SSSR 1922-1972 (Moscow, Statistika: 1972), pp. 103 and 106. Personnel whose primary appointments are elsewhere are excluded from the Academy figures. See footnote 36, above, for the definition of "scientific personnel."

60. Zaleski in OECD, Science Policy in the USSR, p. 68. The decline in the proportion compared to 1956 should not be taken, in itself, as indicating a reduction in the relative share of basic research. The Academy of Sciences of the USSR was fundamentally reorganized in 1961 and 1963 to split off its applied research and development institutes.

61. H. Wienert, "The Organisation and Planning of Research in the Academy System," in OECD, Science Policy in the USSR, pp. 250-54, describes the republic academies as being "closer to production" in the 1960s than was the USSR Academy.

62. S. Mikulinskii ir Kommunist, 1973, 5, p. 79.

63. Ibid., p. 579.

64. See Wienert in OECD, Science Policy in the USSR, p. 318, for the belief that such personnel are not included in the official statistics.

65. Ibid., p. 330.

66. The 1969 figure (in rubles) is taken from Zavlin et al., p. 38. On the assumption that this includes capital expenditures, these are included in the total "science" figure with which it is compared (see Zaleski in OECD, Science Policy in the USSR, p. 100).

67. Zaleski in OECD, Science Policy in the USSR, p. 96.

68. See Wienert in ibid., p. 304, for such a view, but with no supporting evidence presented.

69. Zavlin et al., p. 38. Of course, economic contracts could be signed for basic research; but this appears to be exceptional. An investigation of research institutes showed that as much as 12 percent of their contract research was for theoretic and exploratory projects; this percentage was considered to be high (Amann, Berry, and Davies in OECD, Science Policy in the USSR, p. 468).

70. See N. Tikhonov in Pravda, 7 June 1970, p. 3, translated in Current Digest of the Soviet Press, XXII, 23 (1970), p. 6.

71. Tiamshanskii, p. 26.

72. G. Glagoleva in Voprosy Ekonomiki, 1973, 2, p. 19.

73. Ibid. A breakdown of the data into nine subbranches is given here.

74. E. Krukovskii in Ekonomicheskaia Gazeta, 1974, 13, p. 17.

75. Normally, it is said, only 15 percent of the development projects completed by these R&D institutes are put into production without modifications or additions (Kosov and Popov, p. 102).

Amann, Berry, and Davies in OECD, Science Policy in the USSR, pp. 387-88, discuss the problem of shortage of experimental bases as one which is recognized by Soviet writers to be fundamental; one such writer is quoted as viewing such absence as constituting the "weakest link between science and production." The situation, however, appears to be quite different in the defense industries (ibid., p. 437).

76. L. S. Gliazer in Ekonomika i Organizatsiia Promyshlennogo Proizvodstva (Novosibirsk), 1971, 4, p. 24, as referred to by V. Baranauskas in Planovoe KHoziaistvo, 1973, 12, p. 48.

77. A 1965 estimate has been made, although from quite thin data, as to the proportion of research and development personnel at enterprise level when one defines R&D personnel according to the standard international Frascati definition. The estimate is 11 to 16 percent; at least the lower range of this estimate is well within the range I have suggested, given the difference in definitions. (See Amann, Berry and Davies in OECD, Science Policy in the USSR, pp. 512-14.)

78. G. Glagoleva in Voprosy Ekonomiki, 1973, 2, p. 17.

79. This also seems to be the view of Amann, Berry, and Davies in OECD, Science Policy in the USSR, p. 413 ff. But the data do not all point one way. For example, a sample survey of certificates of authorship awarded in 1966 to different types of Soviet organizations showed that 14 percent were awarded to production enterprises. Of machine tools designed during 1964 and 1965, one-third of those where identification was possible were designed by some production enterprise. In the automotive industry, two major production enterprises invariably prepare their own designs. (Ibid., pp. 413-15, 424, and 421).

80. See Tiamshanskii, pp. 16 and 100, and Amann, Berry, and Davies in OECD, Science Policy in the USSR, p. 411. They report the situation as of the mid-1960s, but there is no indication that it has changed since.

81. Tiamshanskii, pp. 16-21.

82. G. Kulagin in Trud, 5 April 1973, p. 2.

83. Die Wirtschaft, 1973, 17, p. 20.

84. Ibid.

85. Voprosy Ekonomiki, 1970, 11, pp. 63-74, referred to in ABSEES, April 1971, p. 107.

86. IU. Subotskii in Voprosy Ekonomiki, 1973, 3, p. 129.

87. Pravda, 31 May 1974, p. 3, as condensed in Current Digest of the Soviet Press, XXVI, 22, p. 4.

88. IU. Subotskii in Voprosy Ekonomiki, 1973, 3, p. 129.

89. There were a total of about 200 all-Union and territorial ob''edineniia. Of these, 173 were categorized by branch.

90. Even in the precision instruments industry, where one might suspect that this was the prime reason, it appears to have been relatively unimportant. Rather, the ministry of this industry was selected as the one in which to experiment with placing all the main administrations (glavki) of the ministry on economic-accountability (khozraschet) in 1968; these glavki were renamed ob''edineniia at the end of 1970, but with apparently no significance to the renaming. (See K. Rudnev, Minister of the Instrument-Making, Automation and Control Systems Ministry, in Planovoe KHoziaistvo, 1973, 1, p. 9.)

91. See K. Taksir in Voprosy Ekonomiki, 1972, 11, pp. 40-41, and Kosov and Popov, p. 102. As of late 1970, almost half of the R&D and design organizations in the Ministry of Electrotechnical Industry had been made into the head-organization of such an ob''edinenie or other form of combination of development with production (V. Frolov in Pravda, 10 November 1970, p. 2, summarized in Current Digest of the Soviet Press, XXII (1970), 45, p. 13).

92. G. Kulagin, general director of the machine tool ob''edinenie imeni IA. M. Sverdlova, in Trud, 5 April 1973, p. 2.

93. Ibid.

94. N. E. Drogichinskii, head of the USSR State Planning Committee's department for the introduction of new methods of planning and economic incentives, in an interview in Pravda, 31 May 1974, p. 3, summarized in Current Digest of the Soviet Press, XXVI, 22, p. 4; V. Starodubovskii in Voprosy Ekonomiki, 1974, 1, p. 21.

95. Statute of production ob''edineniia, in Ekonomicheskaia Gazeta, 1974, 18, pp. 9-16.

96. For this view, see the authoritative N. E. Drogichinskii, Pravda, 31 May 1974, p. 3, summarized in Current Digest of the Soviet Press, XXVI, 22, p. 4.

97. For the relevant decree, see Pravda, 3 April 1973, pp. 1-2, translated in Current Digest of the Soviet Press, XXV, 14, pp. 1-4.

98. N. E. Drogichinskii, Pravda, 31 May 1974, p. 3.

99. Three examples may be cited from the American literature. P. Selznick in TVA and the Grass Roots (Berkeley, University of California Press: 1949) treats the case of the Tennessee Valley Authority. H. Kaufman in The Forest Ranger (Baltimore, Johns Hopkins Press: 1960) deals with the national forest ranger service. F. M. Scherer, pp. 373-74, comments on the unsuccessful efforts of the Atomic Energy Commission in its early years to motivate desirable contractor performance in this fashion.

100. Calculated from V. Moskalenko in Planovoe KHoziaistvo, 1971, 8, p. 5, and L. Itin and N. Budunova in Planovoe KHoziaistvo, 1973, 10, p. 130.

101. Nevertheless, one Soviet article argues that the mass of enterprise managers and professionals "to a considerable degree" view the size of their individual bonuses as being dependent more on the conditions for the granting of bonuses to their own subcategory of personnel within the enterprise than on the conditions established for the formation of the enterprise's total bonus fund (L. Gubrina, G. Kiperman, N. Kozlov, and A. Rogov in Planovoe KHoziaistvo, 1970, 2, p. 38).

102. See D. Granick, Management of the Industrial Firm in the USSR (New York, Columbia University Press: 1954), Chapter 3.

103. D. Granick, Managerial Comparisons of Four Developed Countries (Cambridge, Mass., MIT Press: 1972), Chapter 8.

An illustration of the slowness of managerial job mobility is given by a Soviet suggestion made in 1970 for speeding the removal of unsatisfactory managers at all levels. The suggestion (which was implemented in at least one ob''edinenie) called for periodic and obligatory removal of 10 percent of the administrators at each level--i.e., those who performed worst. However, no such removal was to be applied to any manager until he had been in post for at least three years. (V. IAkushev and V. IAkhontov in Literaturnaia Gazeta, 2 September 1970, p. 11.)

This notion of a radical increase in the rate of Soviet mobility may be compared with the results of a study of 274 middle- and upper-management executives in six large American industrial companies in the late 1960s; only 20 percent of these American managers had averaged more than three years in post since they were thirty-five years old (Granick, Managerial Comparisons, p. 214).

104. The alternative possible source is a bonus fund of the branch ministry to which the enterprise belongs. As we shall see in Section VIII, this source plays the major role in providing bonuses for general directors of Kombinate in the German Democratic Republic. Nowhere in the Soviet literature have I seen any references to significant bonuses paid from such a ministerial fund to Soviet enterprise managers; but this cannot be taken as proof since the East German literature also makes no such references with regard to German directors. However, Soviet economic literature on bonus incentives is far richer and more honest than the East German, and it seems most likely that references to such a source would be made if it were indeed of major importance. Furthermore, querying of Soviet academics who had recently left the Soviet Union turned up no knowledge of such a bonus source.

105. A. P. Koshkarev and S. S. CHubenko, Planirovanie i Ispol'zovanie Fondov Ekonomicheskogo Stimulirovaniia na Promyshlennom Predpriiatii (Moscow, Finansy: 1969), pp. 70-75. In fact, however, this regulation appears to have been observed somewhat in the breach (Sotsialisticheskii Trud, 1964, 7, pp. 141-42; S. I. SHkurko, Formy i Sistemy Zarabotnoi Platy v Promyshlennosti, Moscow, Ekonomika: 1965, pp. 276-78; A. L. Maksimov, Premirovanie Rabochikh SSSR v Usloviiakh KHozialstvennoi Reformy, Moscow, Nauka: 1971, p. 90).

106. Sotsialisticheskii Trud, 1968, 7, pp. 132-33.

107. Granick, Managerial Comparisons, p. 278; Maksimov, p. 87; N. Maslova in Voprosy Ekonomiki, 1973, 12, p. 45. The 1969 figures are somewhat exaggerated, as they include all bonuses earned; an unknown, but presumably not very large, proportion of such earnings was not in fact paid out. (See N. S. Maslova, Voprosy Ekonomicheskoi Effectivnosti Novoi Sistemy Material'nogo Stimulirovaniia v Promyshlennosti SSSR, Moscow, Nauka: 1971, pp. 168 and 274 for some suggestive material in this regard.)

108. Calculated from Maslova, p. 275. Wages are held constant over the three years in the latter calculation. There is also only a slight tendency in these firms for bonuses to rise over the three years as a proportion of salary. Enterprises are from both light and heavy industry. Since the Soviet author presents the table in order to demonstrate that the variation of bonuses during the time period was slight, there is not reason to believe that the sample of enterprises was specially selected so as to show high variation.

109. Granick, Managerial Comparisons, pp. 279-81; A. I. KHomchenko in Institut Ekonomiki AN Latvinskoi SSR, Ekonomicheskoe Stimulirovanie Povysheniia Effektivnosti Proizvodstva (Riga, Zinatie: 1970), pp. 15-18.

110. In 1968, 82 percent of bonuses paid to managerial and professional personnel on the basis of either short-term or annual results were paid according to monthly or quarterly performance indicators. This percentage applies to the 800 enterprises which were switched in 1966 to the "reform system" of management which had become virtually universal in industry by 1970 (Maksimov, p. 154). The percentage figure cited is consistent with aggregative data for all industry in 1971, when 53 percent of bonuses to all groups in the work-force which were paid out of the relevant bonus fund were distributed on the basis of short-term results; the 53 percent figure includes manual workers, who share in this fund almost exclusively through payments by annual results (N. Maslova in Voprosy Ekonomiki, 1973, 12, p. 45).

111. This management group is defined as consisting of the enterprise director, chief engineer, assistant director, chief economist, head of the planning-economic section, and chief bookkeeper (A. P. Koshkarev and S. S. CHubenko, p. 69).

112. In 1969 the relevant success indicators were three: sales (or, occasionally, profit), profitability, and product mix. However, individual ministries could use other indicators on an exceptional basis for particular firms (ibid., pp. 70-72).

The system was still in force--and for all managers, professionals, and other white collar personnel in the central apparatus of the enterprise, as contrasted with the staffs of the various departments--in late 1973 (F. Veselkov in Voprosy Ekonomiki, 1973, 10, p. 12).

However, some de facto slack obviously exists here, although it is not clear how much. One author presents an example in which managers could receive bonuses for the first two months of a quarter, even though the sales plan of the enterprise was not fulfilled for the quarter as a whole (L. KHaifets in Voprosy Ekonomiki, 1972, 5, p. 118).

113. This model is a systematization of what now appears to be an orthodox view, among both Soviet and Western economists, of Soviet managerial behavior at the enterprise level. The most crucial parts of the model rest particularly upon J. S. Berliner, Factory and Manager in the USSR (Cambridge, Mass., Harvard University Press: 1957) and H. Hunter, "Optimum Tautness in Developmental Planning," Economic Development and Cultural Change, IX, 4 (1961), Part I, pp. 561-72.

114. L. Gubrina, G. Kiperman, N. Kozlov, and A. Rogov in Planovoe Khoziaistvo 1970, 2, p. 37. As of the end of 1968, it would appear that well over 60 percent of total industrial production came from enterprises which were on the reform system (calculated from N. Drogichinskii in Planovoe Khoziaistvo, 1970, 11, pp. 38-39, and E. Gorbunov and L. Timonina in Planovoe Khoziaistvo, 1971, 5, p. 68).

For further discussion of the 1966-70 period, see not only the above articles, but also B. Rakitskii in Planovoe KHoziaistvo, 1973, 5, pp. 4-7, Ekonomicheskaia Gazeta, 1971, 22, pp. 11-14, and Maslova, p. 204.

115. The flavor of the results can be shown by data for the two categories at the tail ends of the distribution.

	Group 1 (Percent)	Group 5 (Percent)
Average planned rate of growth of sales	4.1	25.6
Fulfillment of sales plan	104.6	102.6
Fulfillment of profitability plan	109.1	108.0
Additional bonus earnings for 1 percent plan overfulfillment (as proportion of planned bonus earnings):		
a. Of sales plan	15.5	2.9
b. Of profitability plan	1.5	0.7
Bonus fund as proportion of wage fund:		
a. Planned	9.5	10.2
b. Actual	12.6	10.7
Enterprises in category		
(Number)	5	5

A major weakness of the study is that it refers to the year 1967; as of January 1967, only 704 enterprises in the entire USSR had been transferred to the new system of planning, and these were highly exceptional enterprises. Similar data for a later year, and thus for a more representative sample, might not have shown the same results.

Data are taken from Table 1 of V. Kletskii and G. Risina in Planovoe KHoziaistvo, 1970, 8, pp. 51-58. The authors do not in this article identify the year studied, but identification is given by the same authors in Voprosy Finansov, Kredita, Bukhgalterskogo Ucheta i Statistiki, 1 (1970: Minsk), pp. 32-39.

Khomchenko, in Institut Ekonomiki AN Latvinskoi SSR, pp. 6-7, comes to the same conclusion: that the change in the bonuses for above-plan performance was insufficient to lead firms to desire ambitious plans. His analysis is based on the 1968 experience of a small group of Latvian machinebuilding and metalworking enterprises.

116. See, for example, G. Egiazarian in Voprosy Ekonomiki, 1973, 1, pp. 111-12.

117. Koshkarev and Chubenko, pp. 1-18, present an excellent handbook treatment of the calculations.

118. Nevertheless, the degree of at least the financial-incentive perversity declined markedly during the post-1965 period. For the economy as a whole (not solely industry), the treatment of planned and above-plan profits changed as follows during the 1960s:

	1961	1965	1970
	(Percent)		
Proportion of profits earned which went into the enterprise fund of economic stimulation[a]			
a. Planned profits	3.0	3.8	13.3
b. Above-plan profits	27.4	34.4	24.4
Above-plan profits ratio divided by planned-profits ratio (b÷a)	913	905	184

[a] This fund includes bonuses but is much broader.
(Calculated from Garetovskii, pp. 121-24.)

119. V. Rzheshevskii (the head of a subunit of the USSR State Planning Commission) in Planovoe KHoziaistvo, 1971, 9, pp. 9-11. An alternative index to that of production consists of the total amount of profits earned; the tone of the article suggests that this is rarely used. The author, however, goes on to indicate additional indices without specifying clearly whether they apply to the ministries; I assume that they apply only to the subdividing of the ministry's total fund to the enterprise level, as otherwise the article is internally contradictory. An official State Planning Commission explanation of the system indicated that the ministerial fund was linked both to sales and to the rate of profitability (Ekonomicheskaia Gazeta, 1971, 22, pp. 11-14), but the first author later stated categorically that no index of profitability was ever approved for the ministries (V. Rzheshevskii in Planovoe KHoziaistvo, 1973, 3, p. 60).

Support for the statement in the text is provided by the economic code department of the USSR State Labor and Wages Committee in Ekonomicheskaia Gazeta, 1973, 2, p. 16, and 1973, 4, p. 16, referred to in Current Digest of the Soviet Press, XXV, 14 (1973), pp. 23-25. While Rzheshevskii had written that production is measured in current prices (as tovarnaia produktsiia), this source says that constant prices (valovaia produktsiia) are employed--and its logic for why this must be done appears convincing.

The statement in the text seems to me to be the most likely to be correct. For our purposes here, however, it does not matter.

120. Rzheshevskii in Planovoe KHoziaistvo, 1971, 9, p. 9.

121. Ibid., 1973, 3, pp. 57-58. The reduction per ministry fell within the range of 9.3 and 15.8 percent.

122. Ibid., p. 61. The Minister of Instrument-Making, Automation and Control Systems, whose ministry is one of those which has gone the furthest in carrying out the industrial reform, wrote at the beginning of 1973 that his ministry was still unable to develop long-term bonus systems for individual ob'edineniia or enterprises (K. Rudnev in Planovoe KHoziaistvo, 1973, 1, pp. 10-14).

123. The only unusual index which the writer has seen employed is the capital/output ratio (N. Glushkov in Planovoe KHoziaistvo, 1973, 3, p. 65).

124. See N. Rogovskii in Planovoe KHoziaistvo, 1972, 10, p. 23, and Garetovskii, pp. 173-75. However, in the Ministry of Nonferrous Metallurgy, 80 percent of the enterprises were on group norms (N. Glushkov in Planovoe KHoziaistvo, 1973, 3, p. 66).

125. Decision of 16 January 1974, published in Ekonomicheskaia Gazeta, 1974, 4, p. 15.

126. See V. Bitunov in Planovoe KHoziaistvo, 1971, 8, pp. 22-26, for the degree of such sensitivity in the machine tool industry.

127. Scherer, pp. 220-22.

128. Ibid., pp. 245-52.

129. Ibid., pp. 192-204.

130. In a sample consisting of 50 very large American industrial corporations, which is considered representative of this population of firms, the share of earnings from stock options alone in the after-tax equivalent of compensation paid to the top five executives in each corporation was as follows:

Stock option earnings as percentage of total compensation (1955-63 average)	27 percent
Stock option earnings as percentage of salary and bonus (1955-63 average)	51 percent

These percentages exclude earnings from corporate profit-sharing plans (which for our purposes would have been appropriate to include here), as well as from holdings of the stocks of the manager's own company. (W. G. Lewellen, Executive Compensation in Large Industrial Corporations, New York, National Bureau of Economic Research: 1968, p. 143).

The rank correlation between salary plus bonus and total compensation (defined as salary and bonus, pension benefits earned, deferred compensation and profit sharing, and stock option earnings) in these companies during 1955-63 was only 0.6 (ibid., pp. 147-238).

It should be noted, however, that these data relate to an historical period in which the movement of stock market prices was quite different from that of the last few years.

If we were to consider only a population of companies which are in a period of major success, the importance of equity interest to top managers would be far higher. It is such a population of corporations which would be really relevant for the point made here.

131. The issue is somewhat debatable for a worker's management socialist economy of the Yugoslav variety.

132. This is defined as total profits divided by the "production capital" of the enterprise. Production capital excludes the value of buildings and equipment used for social purposes (restaurants, kindergardens, etc.), but includes all other fixed capital and material stocks of working capital (excluding in practice, although not in theory, that financed by bank loans). Buildings and equipment are valued according to their unamortized portion only, and exclude capacity not yet officially "introduced into production." (See D. Allakhverdian in Voprosy Ekonomiki, 1970, 11, pp. 66-67; V. Senchagov and V. Miliaev in Planovoe KHoziaistvo, 1970, 10, p. 13; B. Rakitskii in Planovoe KHoziaistvo, 1973, 5, p. 14.)

133. These are measured in current prices.

134. Estimated from Garetovskii, p. 164, where data for light industry and food industry are given.

135. As of 1969, it was required that such reduction be at least 40 percent when a given quarter's product-mix plan was not fulfilled; however, up to half of the reduction for a quarter could be annulled if the product-mix target was met for the year as a whole (Koshkarev and CHubenko, pp. 17-18).

136. K. Kedrova in Voprosy Ekonomiki, 1972, 7, p. 59.

137. A. Antonov in Planovoe KHoziaistvo, 1973, 5, p. 23.

138. V. Kas'ianov in Ekonomicheskaia Gazeta, 1974, 10, p. 10.

139. In 1971 an interdepartmental commission attached to the USSR State Planning Commission decided that the proportion of enterprise bonus funds attached to sales during 1971-75 should be at least 40 percent, and at least 60 percent in consumer-goods enterprises (D. Ukrainskii in Planovoe KHoziaistvo, 1971, 8, p. 50). In early 1973, some 30 to

40 percent of the moneys in the enterprise bonus funds of all industry were said to be coming from the sales and profits indicators, and some 60 to 70 percent from the profitability indicator (A. Mkrtychev in Planovoe KHoziaistvo, 1973, 2, p. 70).

140. B. Rakitskii in Planovoe KHoziaistvo, 1973, 5, pp. 110-11; N. Drogichinskii in Voprosy Ekonomiki, 1972, 6, pp. 39-40; V. Rzheshevskii in Planovoe KHoziaistvo, 1973, 3, p. 55. For some earlier experiments in this direction, see S. SHkurko in Planovoe KHoziaistvo, 1969, 12, pp. 50-54; L. Gubrina, G. Kiperman, N. Kozlov, and A. Rogov in Planovoe KHoziaistvo, 1970, 2, p. 37; T. Baranenkova in Voprosy Ekonomiki, 1970, 2, pp. 51-59.

141. The reader may wonder why this new success indicator was necessary, since wage economies or diseconomies were already reflected in the profitability index which was the main determinant of the enterprise bonus fund. The reason is that the enterprise bonus fund was planned to attain--under normal work conditions--a given percentage of the wage fund. Although increases or decreases of wage expenditures, when these were proportional to changes in employment, would not affect the per capita bonus fund, it must be remembered that the enterprise bonus fund is used primarily to reward white-collar rather than manual workers. Thus an improvement in the labor productivity of manual workers in an enterprise, if there was no compensating improvement in the labor productivity of white-collar workers, would actually reduce the enterprise bonus fund per white-collar worker which would be available in following years (T. Baranenkova in Voprosy Ekonomiki, 1970, 2, p. 51).

142. See V. Rzheshevskii in Planovoe KHoziaistvo, 1973, 3, p. 56; K. A. Efimov, pp. 59-60 and F. E. Astaf'ev, pp. 221-23 in Gatovskii, Planirovanie i Stimulirovanie Progressa; N. K. Baibakov in Trud, 23 May 1974, p. 2, summarized in Current Digest of the Soviet Press, XXVI (1974), 27, p. 2.

A prelude to this indicator had existed since 1969, and did affect a few enterprises of other subbranches. But it had no quantitative importance (D. Ukrainskii in Planovoe KHoziaistvo, 1971, 8, p. 50).

In the electrical equipment subbranch, this indicator not only affected the distribution of the ministry's total five-year bonus fund among its individual enterprises, but the performance by this criterion of the ministry as a whole was also relevant in determining the ministerial fund available each year (V. Rzheshevskii in Planovoe KHoziaistvo, 1973, 3, p. 62).

143. As of 1966, for example, the wage fund of an enterprise in the machine-building sector would automatically rise by 0.6 percent for every 1 percent overfulfillment of its production plan, and would decline by 1 percent for every 1 percent underfulfillment (V. E. Popov, Organizatsiia Zarabotnoi Platy na Predpriiatiiakh Mashinostroeniia, Kiev, Tekhnika: 1966, p. 161). For a more recent reference, see N. Rogovskii in Planovoe KHoziaistvo, 1972, 10, p. 24.

144. Maslova, pp. 274-76.

145. Ibid., p. 298.

146. I. Maslova and V. Moskvich in Voprosy Ekonomiki, 1970, 3, pp. 97-98.

147. In a study of 118 enterprises which had been shifted to the reformed planning system by early 1967, the proportions of manual-worker bonuses financed from the wage fund were: 1967, 74 percent; 1968, 63 percent; and 1969, 64 percent (Maslova, p. 282).

148. Koshkarev and CHubenko, pp. 17-18 and 70.

149. I have seen no discussion as to this vital issue, but "benign neglect" is suggested by the usual bypassing in Soviet writing of product-mix as a relevant index for bonuses. In one listing of plans approved for the enterprise by higher organs (direktivnye plany), for example, product mix is completely left out (IA. Itskovich in Planovoe KHoziaistvo, 1973, 10, p. 73).

150. V. Moskalenko in Planovoe KHoziaistvo, 1971, 8, pp. 56-57. The same principle is stated to hold in the electrical equipment industry (T. Brazovskaia and V. Petrova in Planovoe KHoziaistvo, 1971, 10. p. 22).

151. P. Buch in Trud, 5 June 1973, p. 2.

152. Ibid. The author was a corresponding member of the USSR Academy of Sciences, and chairman of one of its scientific councils.

153. D. Ukrainskii in Pravda, 13 June 1974, p. 3, as translated in Current Digest of the Soviet Press, XXVI (1974), 24, pp. 7-9.

154. For a listing of the industrial ministries which have the right to such a fund, and for the amount of the fund of each ministry as a percentage of its total costs of production, see L. M. Zotova, D. IA. Komarova, and IA. S. Semenkov in Tokachev and Denisenko, p. 31.

A "unified fund for the development of science and technology" was introduced in the Ministry of the Electrotechnical Industry, in 1969. It is set as a proportion of branch output and is deducted by the Ministry from profits. Its purpose is to unify and consolidate the financing of applied research, development and assimilation (through the first year of batch production) into one ministerial fund. So far, however, its use has not spread to many other ministries, perhaps in connection with the extensive debate going on concerning the proper source--profits or cost of production--for new technology incentive funds. Therefore, as of now, this "fund has only potential rather than actual significance" for the funding of new technology (L. E. Nolting, Sources of Financing the Stages of the Research, Development, and Innovation Cycle in the USSR, pp. 33-34).

155. Calculated from ruble figures in Garetovskii, pp. 245-46. Similar breakdowns are available for 1969-1971 for expenditures on assimilation of new types of industrial products (L. Orlova and G. TSaritsyna in Voprosy Ekonomiki, 1973, 10, pp. 54-55).

156. In 1969 in the Ministry of Electrotechnical Industry, profits earned on all products assimilated into the enterprises' production programs in that same year earned only 3.6 percent profit as a percentage of sales price, in contrast to an average of 18.7 percent for all products of the ministry which had been assimilated during earlier years (K. Kedrova in Voprosy Ekonomiki, 1970, 4, p. 98). A study of enterprises in nine machinebuilding ministries showed that, in 1970, 68 percent of the products assimilated into production for the first time in the USSR during that year either suffered losses or earned substantially lower rates of profitability than average for the sector (Gatovskii, Planirovanie i Stimulirovanie Progressa, p. 32). Calculations made for the Ministry of Tractors and Agricultural Equipment showed that the assimilation of new products reduced the enterprise bonus funds of that ministry by 13 percent in 1969 compared with what they would otherwise have been (K. Kedrova in Voprosy Ekonomiki, 1970, 4, p. 98).

157. Prior to 1967, profitability in price setting was calculated as a profit/cost ratio. For a discussion of the principles for pricing new products, see A. Koshuta and IU. Borozdin in Planovoe KHoziaistvo, 1973, 8, pp. 6-14.

158. A. Komin in Voprosy Ekonomiki, 1974, 3, p. 17.

This price index of the USSR Central Statistical Office has been sharply criticized by some Soviet authors, and should perhaps not be used as a general index of machinery prices. It is based on a sample of 350 items taken from 1967, but items are dropped without replacement when they are removed from general production. All specialized, one-of types of equipment are excluded from the index; some critics think that there has been inflation in the price of such items. Writing of the earlier period of 1961-66, one critic says that the average increase in equipment expenditures, compared to the original estimates, was 22 percent for a large group of new construction projects of all-Union ministries and departments; assuming that at least half of this increase was due to hidden price increases, he estimates a 2 percent annual increase of machinery prices. (Palterovich, Park Proizvodstvennogo Oborudovaniia, pp. 188-98). This 2 percent per annum increase contrasts with a 2 percent per annum decline in the official price index of the machinebuilding and metalworking branch during these years (Narodnoe Khoziaistvo SSSR v 1972 g., pp. 197 and 199). See also, A. Becker, "The Price Level of Soviet Machinery in the 1960s," Soviet Studies, XXVI:3 (July 1974), pp. 363-379.

This issue, however, need not concern us here. Our interest is in the change in production costs for products which are continued in production, and we estimate this by the price change of these products. For this purpose, the Central Statistical Office index is indeed what we want.

159. Prices in this subbranch fell by 17 percent between 1967 and January 1973; 8 percent by 1972 and a further 9 percent in January 1973 (M. Sukhopleshchenko in Planovoe KHoziaistvo, 1973, 1, pp. 118-19). In 1969, the profit/price ratio of the subbranch was 19 percent (K. Kedrova in Voprosy Ekonomiki, 1970, 4, p. 98).

160. L. Gatovskii in Voprosy Ekonomiki, 1972, 2, p. 17.

161. V. Bitunov in Planovoe KHoziaistvo, 1971, 8, p. 24.

162. T. Brazovskaia and V. Petrova in Planovoe KHoziaistvo, 1971, 10, pp. 22-23.

163. See Section I.

164. The 1970 plan for the Ministry of the Electrotechnical Industry called for a profit/cost ratio of 14 to 15 percent for "new" products as compared with a 24 percent ratio for all products (G. Kondrashov in Planovoe KHoziaistvo, 1973, 8, pp. 53-54). However, there appears to be no precise definition of "new products" in Soviet practice (IA. Kvasha in Voprosy Ekonomiki, 1969, 3, p. 30), and thus not much confidence should be placed in these figures; it is even possible that the term "new products" as used here refers only to those assimilated into production during the current year.

A calculation which appears to relate to the early 1970s was made by the All-Union Institute of Transformer Building as to the relative profit/cost ratios of different models of transformers.

Year Since the Model was First Placed into Production	Profit/Cost Index
2nd year	100
10th year	114.3
15th year	123.2

What is perhaps most striking is the substantially greater profitability of 15-year-old than of 10-year-old models.

The same situation, although usually to a lesser extent, was said also to characterize various other branches of machinebuilding--especially tractor production. (L. Gatovskii in Voprosy Ekonomiki, 1972, 2, p. 17.)

In the Ministry of Electrical Equipment in 1969, all products had an average profit/price ratio of 19 percent. However, those items taken out of production in that year had had an average profit/price ratio of 40 percent (K. Kedrova in Voprosy Ekonomiki, 1970, 4, p. 98).

Three English students, R. Amann, M. J. Berry and R. W. Davies, writing of the pre-1967 period, also think that the price ratio of new to old prices is unfavorable to assimilation of new products. They cite two regional studies of machinebuilding in 1959 and 1963 in support of their view, but these studies appear to suffer from lack of a sharp definition of "new products." (OECD, Science Policy in the USSR, pp. 478-79.)

165. See Ekonomicheskaia Gazeta, 1972, 20, p. 7, as summarized in ABSEES, October 1972, p. 18.

166. See, for example, A. V. Bachurin in Gatovskii, Planirovanie i Stimulirovanie Progressa, pp. 139-41.

167. In 1970, for example, the USSR State Planning Committee recognized that the level of profitability of existing products in machinebuilding was unjustifiably high; it held that this high level inhibited the assimilation of new products by the branch. Yet it declared that no mass revision of machinebuilding prices was possible before January 1973. (I. Sher in Voprosy Ekonomiki, 1970, 6, p. 33, with reference to Ekonomicheskaia Gazeta, 1970, 11, p. 6.)

168. Amann, Berry and Davies in OECD, Science Policy in the USSR, p. 478; reference is to an article by S. Barngol'ts in Promyshlenno-ekonomicheskaia Gazeta, 23 January 1959.

169. IU. V. IAkovets in Gatovskii, Planirovanie i Stimulirovanie Progressa, p. 171.

170. IA. Kvasha in Voprosy Ekonomiki, 1969, 3, p. 34.

171. IU. V. IAkovets in Gatovskii, Planirovanie i Stimulirovanie Progressa, p. 171. The decree of June 1966 restricted the use of temporary prices to products which were being produced in batches for the first time in the USSR as a whole, rather than for the first time in the individual enterprise. The lifetime of temporary prices was restricted to nine months, with modification up to fifteen months for products with a lengthy production cycle. The profit/cost ratio was restricted to a maximum of 10 percent of costs during the first year of production. (Ibid. In 1966, the average profit/cost ratio for all of industry was 10.7 percent. This latter percentage is calculated from Palterovich, Park Proizvodstvennogo Oborudovaniia, p. 283, and V. Senchagov, M. Pevzner, and L. Bugaets in Voprosy Ekonomiki, 1973, 8, p. 74.)

172. D. UKrainskii in Planovoe KHoziaistvo, 1971, 8, p. 50. However, since the author does not define his use of the term "obsolete," the "fact" of decline may be only apparent.

173. A. Koshuta in Voprosy Ekonomiki, 1973, 7, pp. 3-6.

174. G. Kondrashov in Planovoe KHoziaistvo, 1973, 8, p. 53.

175. The system of price supplements has relevance only for products replacing substitute items used in the production process. It is not used for products serving new needs or representing basically new technology, nor for goods intended for final consumers (A. Koshuta and IU. Borozdin in Planovoe KHoziaistvo, 1973, 8, pp. 7-14).

176. See K. A. Efimov, IU. V. IAkovets and V. E. Astaf'ev in Gatovskii, pp. 59-60, 175, 182-83, and 228-29; G. Kondrashov in Planovoe KHoziaistvo, 1973, 8, p. 53.

177. V. K. Sitnin in Ekonomicheskaia Gazeta, 1970, 11, pp. 5-6, as summarized in Current Digest of the Soviet Press, XXII (1970), 14, p. 9.

178. A. Koshuta and IU. Borozdin in Planovoe KHoziaistvo, 1973, 8, p. 14.

179. These price changes occurred after the 1967 general price revision for all industrial products, and prior to the next general price revision.

180. This leaves aside temporary prices and price supplements, but these have been quite minor since the 1967 revaluation of constant prices.

181. See Ekonomicheskaia Gazeta, 1971, 41, p. 8 as summarized in ABSEES, April 1972, p. 87; M. Sukhopleshchenko in Planovoe KHoziaistvo, 1973, 1, p. 119; and A. Koshuta and IU. Borozdin in Planovoe KHoziaistvo, 1973, 8, pp. 7-14. Sukhopleshchenko offers the same interpretation that I do as to the relative movement of the two price ratios. For a contrary view, see A. Becker, Soviet Studies, July 1974, pp. 374-379. (Most of Becker's analysis pertains to the period before 1967. He argues that machinery prices continued to rise after 1967, but at a substantially reduced rate.)

182. See the "fuller model" in Section V.

183. S. E. Rogovtsev, Planirovanie i Finansirovanie Novoi Tekhniki na Predpriiatii (Moscow, Ekonomika: 1965), pp. 15-28, and Garetovskii, p. 252.

184. V. G. Zakharov and N. I. IAshen'kin in Gatovskii, pp. 189-90.

185. See Garetovskii, pp. 253-54.

186. Figures relating to the industrial enterprise level for 1960, 1966, and 1967 show 40 to 52 percent to have been unused annually in industry as a whole (G. Tamoshina in Planovoe Khoziaistvo, 1970, 3, p. 59). Figures for industry as a whole during 1965-1969 show the unused annual portion to have risen steadily from 46 to 67 percent (Garetovskii, pp. 253-54).

187. Garetovskii, p. 254.

188. In 1972, the last date for which such data are available, 26 percent of the total production of this subbranch fell into the top category, and 16 percent into the lowest category (V. Astaf'ev in Planovoe KHoziaistvo, 1973, 3, p. 77).

189. Kornai argues that the gravest consequence of permanent sellers' markets is the almost complete absence of revolutionary product development (Kornai, p. 287).

190. See L. Margolin in Sovetskaia Torgovliia, 8 January 1972, p. 3, and V. Perevedentsev in Literaturnaia Gazeta, 1974, 17, p. 11, both translated in Current Digest of the Soviet Press, XXIV (1972), 2, pp. 1-4, and XXVI (1974), 18, p. 4.

191. This model was still produced by 20 of the 33 enterprises in the USSR which were then producing washing machines.

192. This last fact may be accounted for by the power requirement of such machines, which exceeds the wiring capacity of apartment houses. Such a power requirement does not, however, seem to characterize the semi-automatic machines.

193. However, when trade organizations took up the matter at a sufficiently high organizational level, they did have some success in reducing their orders. The USSR Ministry of Domestic Trade asked for a cutback in washing machine production by 900,000 units in 1970; it achieved a planned cutback of 500,000.

194. This was noted at the December 1973 meeting of the Central Committee of the USSR Communist Party (N. Baibakov, chairman of the USSR State Planning Commission, in Planovoe Khoziaistvo, 1974, 3, pp. 8-9).

195. Ibid., pp. 9-10.

196. Until 1969, half of the planned bonus fund of the R&D or design organization went into a centralized ministerial fund from which it was redistributed. Both the retained and ministerially-redistributed portions were paid out in bonuses in relation to the organization's fulfillment of its thematic plan; whether the work was determined to be useful in production, or was in fact ever used, had no relevance to such payments. (V.E. Astaf'ev in Gatovskii, p. 230.)

197. The mock-up stage is calculated as requiring over 50 percent of the total number of man-years needed for the total development (razrabotka) stage in machinebuilding (G. Glagoleva in Voprosy Ekonomiki, 1973, 2, p. 22).

198. The organization is allowed to keep 75 percent of all profits earned beyond those calculated into the original estimates for the work.

199. The changing formulae used for calculating profits are given by L. Fatava in Planovoe Khoziaistvo, 1973, 1, pp. 68-69.

200. Where no such calculation is feasible, the contract price for the work includes a supplemental 20 percent of the planned wage fund of those personnel working directly on the project.

201. This was a study (year unstated) carried out by the Electrical Equipment Institute as to the results of completed projects of 25 R&D organizations in the electrical equipment industry. Total profits earned constituted 11 percent of total payments received by these organizations. Following the numbering system used above in the text, they were broken down as follows:

1st category	3 percent of total receipts
2nd category	6 percent
3rd category	2 percent

Furthermore, the absolute variation among individual organizations in profit as a percentage of total payments was far greater in the second category than in either of the other two. (Ibid., p. 70.)

202. G. Petrov in Pravda, 21 May 1974, p. 3, as condensed in Current Digest of the Soviet Press, XXVI (1974), 20, p. 13.

203. G. Kulagin in Trud, 5 April 1973, p. 2.

204. G. Petrov in Pravda, 21 May 1974, p. 3.

205. Actually, a 20 percent average adjustment was made to the costs of purchasing and using the product to be supplanted; this reduction was intended to reflect the expected secular fall in the costs of production in general (IU. V. IAkovets in Gatovskii, Planirovanie i Stimulirovanie Progressa, p. 186).

206. Ibid.

207. A. Koshuta and IU. Borozdin in Planovoe Khoziaistvo, 1973, 8, p. 14. In early 1974 the USSR State Committee on Prices was still at the stage of thinking that limit prices constituted a "good idea" (A. Komin in Ekonomicheskaia Gazeta, 1974, 11, p. 10).

208. This is the impression gained by the writer of this report from a large number of lengthy interviews (which, however, concentrated on other matters) over some ten months during 1970-71 in Czechoslovakia, the GDR, Hungary, Poland, and Romania.

209. This is more so in the GDR than in other CMEA countries because of the heavy emigration, prior to the construction of the Berlin Wall in 1961, of personnel with prior managerial and professional experience.

210. In 1936, the territory of the present GDR (without Berlin) received 45 percent of its total net consumption of agricultural and industrial goods from other parts of the German Reich; today, this share stands at little more than 2 percent. (W. Bröll, Die Wirtschaft der DDR, München-Wien, Günter Olzog: 1970, p. 118. Bröll's 2 percent estimate excludes imports of the GDR from that part of Poland which formerly belonged to the German Reich.)

211. For a discussion of hard- and soft-good trade within the CMEA block, see S. Ausch, Theory and Practice of CMEA Cooperation (Budapest, Akadémiai Kiadó: 1972), especially Chapter 7.

212. This comparison has been made by knowledgeable academics in interviews in both the GDR and in Czechoslovakia.

213. The sample data are derived from interviews conducted by the writer during the summer of 1970. For a full treatment of the sample, and comparison of it with similar samples from Hungary, Romania, and Yugoslavia, see D. Granick, Comparisons of Enterprise Guidance in Socialist Economies: Eastern Europe (Princeton, Princeton University Press: 1975 forthcoming), Chapter 1'.

214. A Kombinat represents a merger of formerly-independent enterprises, and is best treated as itself being a large enterprise. Discussion throughout this report will treat the Kombinat as a form of enterprise; planning and managerial incentive systems are identical in both types of organizations. The VVB (Vereinigung Volkseigener Betriebe) is an organization intermediate between the industrial ministry and the Kombinat.

215. See, for example, V. IAkushev and V. IAkhontov in Literaturnaia Gazeta, 2 September 1970, p. 11.

216. See D. Granick, Managerial Comparisons, Chapter 9.

217. The January 1972 regulations are presented in Gesetzblatt der Deutschen Demokratischen Republik, II, 1972, 5, pp. 49-53. Calculations were made from data as to average payments of end-of-year bonuses, taken from Die Wirtschaft, 1972, 7, p. 10, and 1973, 15, p. 7. For such calculations, it is assumed that 80 percent of the bonus fund of

Ministerially-directed industry was distributed in the form of end-of-year bonuses, and that the planned bonus fund of industry was equal to 90 percent of the actual bonuses paid out.

218. The reduction down to 40 percent of the planned bonus fund can occur due to failure to fulfill other indices of the plan than profits or profitability: e.g., the labor productivity or product-mix plan (V. Rzheshevskii in Planovoe KHoziaistvo, 1973, 3, p. 58).

219. Pravda, 10 August 1955, p. 1.

220. For an opposite view with regard to the period since 1968 in East German industry as a whole, see M. Keren, "The New Economic System in the GDR: An Obituary," Soviet Studies, XXIV, 4 (April 1973).

221. Plan fulfillment reports in Die Wirtschaft, 1973, 4, p. 15 and 1974, 5, p. 14.

222. Die Wirtschaft, 1973, 29, p. 13.

223. This percentage is calculated on the assumption that enterprises under ministerial jurisdiction produced three-quarters of total industrial production in 1973.

224. Granick, Comparisons of Enterprise Guidance, Chapter 6.

225. Ibid.

226. At the time of my interviews there, one division of a large American industrial company had achieved its profit plan in five of the previous six years, and in the sixth year had missed it by only 10 percent. This was possible because of a hedge against uncertainty which existed in its profit plans. Yet, despite the existence of this demonstrated hedge, the division never turned in a single year's profits that were better than planned. (Granick, Managerial Comparisons, p. 36.)

227. For an elaboration of the two models within this framework of analysis, see Granick, Managerial Comparisons, Chapter 2.

228. In a Soviet survey carried out during roughly 1966-67 among Soviet professionals, junior managers, and middle managers, overfulfillment of plan held first place among the activities rewarded by bonuses. (A. A. Zvorykin and A. M. Celiuta in G. V. Osipov and J. Szczepański, Sotsial'nye Problemy Truda i Proizvodstva, Moscow, Mysl': 1969. This article was translated in full in International Studies of Management & Organization, fall 1973, and reference is to p. 111 there.)

229. Evidence for such subjectivity of career decisions can be deduced from one American corporation's records. If one assumes that the manager's direct superior, as well as the superior one-level above,

are accepted within the company as the best judges of his performance when objective, short-term criteria are employed, then we can use the two-year transfer data of the late 1960s for one company; these data cover all managers and professionals who were either promoted or who changed subunits within the firm. (Sample size is between 750 and 1,500 managers and professionals; the number cannot be specified more closely for fear of identifying the company.) No correlation existed between prior performance rating and extent of promotion, nor did one appear when other independent variables were introduced into the regression equation (Granick, Managerial Comparisons, pp. 303-05).

230. Granick, Comparisons of Enterprise Guidance, Chapter 7.

231. Deutsches Institut für Wirtschaftsforschung, DDR-Wirtschaft (Frankfurt am Main and Hamburg, Fischer Bücherei: 1971), p. 86.

232. A. Nagovintsin in Planovoe KHoziaistvo, 1974, 2, p. 89.

233. See Section IV.

234. G. Kulagin in Trud, 5 April 1973, p. 2.

235. Decision of the GDR State Contract Court, reported in Die Wirtschaft, 1974, 19, p. 20.

236. See G. Zillmann, deputy minister for Science and Technology, in Die Wirtschaft, 1974, 15, p. 4; W. Marschall in Wirtschaftswissenschaft, 1972, 9, pp. 1346-47; H. Seickert in Wirtschaftswissenschaft, 1973, 3, p. 427.

237. See Granick, Comparisons of Enterprise Guidance, Chapter 14, for an example of this.

238. V. Dozortsev in Planovoe KHoziaistvo, 1973, 7, p. 121.

239. Gesetzblatt der Deutschen Demokratischen Republik, II, 1971, 75, pp. 641-44, and II, 1972, 73, p. 846.

240. L. Orlova and G. TSaritsyna in Voprosy Ekonomiki, 1973, 10, p. 55.

241. Gesetblatt der Deutschen Demokratischen Republik, II, 1972, 73, p. 841.

242. Die Wirtschaft, 1973, 37, supplement 20, p. 12.

243. H.-D. Haustein and W. Marschall in Wirtschaftswissenschaft, 1974, 2, p. 282.

244. Harry Maier, of the Central Institute of Economics and of the Academy of Science, in a statement at a theoretic seminar held in September 1972 on the assimilation of scientific results into production. This

statement is reported without criticism by Heinz Seickert in Wirtschaftswissenschaft, 1973, 3, p. 429.

245. Even a shift to the Hungarian type of planned market socialism would not necessarily affect this seller's market condition. It has not, for example, in Hungary itself. (See Granick, Comparisons of Enterprise Guidance, Chapters 8-10.)

Appendix B

LIST OF BOOKS CITED

Appendix B

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References to articles are complete within each footnote. References made in the footnotes to authors alone refer always to their books and not to their articles.

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