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ECONOMIC INTELLIGENCE REPORT

**THE OPERATING EFFICIENCY
OF THE SOVIET MARITIME CARGO FLEET
1950-58 AND PLANS FOR 1959-65**



CIA/RR 59-24

June 1959

CENTRAL INTELLIGENCE AGENCY

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FOREWORD

This report deals with the efforts made by the USSR to raise the operating efficiency of its maritime cargo fleet, with the problems involved in the task, and with the progress which has been made and which remains to be made in raising this efficiency. The operating efficiency of the fleet is important because it indicates the return, measured in ton-miles of cargo turnover, which the USSR is receiving for the resources and capital invested in its fleet and ports and because it influences the amount of foreign exchange which the USSR spends for the chartering of foreign vessels.

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THE OPERATING EFFICIENCY OF THE SOVIET MARITIME CARGO FLEET*
1950-58 AND PLANS FOR 1959-65

Summary

The first detailed plan figures for the growth of Soviet maritime transportation during the Seven Year Plan (1959-65) were released on 18 December 1958. These figures covered the performance of the Soviet maritime cargo fleet in ton-miles,** increases in the cargo-carrying capacities of both the tanker and the dry cargo segments of the fleet,*** and three of the most important indexes**** of fleet operating efficiency. In the cases of fleet performance and fleet operating efficiency, the planned annual rates of growth are generally lower than the actual rates during the 8 years, 1951-58, which comprised the Fifth Five Year Plan (1951-55) and the first 3 years of the original Sixth Five Year Plan (1956-60). The average annual rate of growth for fleet cargo-carrying capacity in the Seven Year Plan is greater, however, than the average annual rate of growth during 1951-58.

The fact that there is no planned increase in the rate of growth of fleet performance corresponding to the planned increase in the rate of growth of fleet cargo-carrying capacity can be accounted for to a considerable extent by planned decreases in the rates of growth of two important indexes of fleet operating efficiency -- productivity of cargo-carrying capacity and cost of shipments. A study of Soviet efforts to raise the operating efficiency of the fleet through 1958 gives the impression that the rates of growth of these indexes of operating efficiency should be expected to rise during the Seven Year Plan. The main reason for this belief is that the vessels which are planned to be added to the fleet in considerable numbers during that

* The estimates and conclusions in this report represent the best judgment of this Office as of 15 April 1959.

** Although Soviet performance figures for inland transport are normally reported in terms of ton-kilometers, similar maritime data usually appear as ton-miles. A ton-mile is the movement of 1 metric ton of cargo the distance of 1 nautical mile.

*** Comprising all of the tankers and dry cargo vessels subordinate to the Ministry of the Maritime Fleet (Ministerstvo Morskogo Flota), including those of the Caspian Roadstead, Caspian, and Danube Steamship Companies and excluding those of the Central Asiatic Steamship Company and those not employed in the shipment of cargoes. The tanker segment and the dry cargo segment of the fleet are hereafter referred to as the tanker fleet and the dry cargo fleet, respectively.

**** The term index as used in this report refers to indicators of operating efficiency.

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period will include a high proportion which are modern in design and which are highly efficient in their operation. Thus, from the point of view of fleet composition, the operating efficiency of the fleet should for a time experience an accelerated growth.

Although fleet composition as well as port adequacy is important, there are other factors which also influence the operating efficiency of the fleet. Most important is ready availability of cargo. As Soviet shipping activities are expanding, particularly in foreign trade, this factor is causing the USSR problems for which there are no easy solutions. One such problem is obtaining return cargoes on trade routes where there is a heavier flow of traffic in one direction than in the other. The movement of POL from the Black Sea to Western Europe is the best example. A large proportion of the Soviet tankers in this trade return to Soviet ports in ballast. Because the preponderance of exports over imports in Soviet seaborne foreign trade is increasing, similar situations are developing in the movement of dry cargoes as well.

The tapering off in the rates of growth of the two indexes of operating efficiency -- productivity of cargo-carrying capacity and cost of shipments -- therefore may be explained by the fact that the USSR has reached a point in the expansion of its shipping activities beyond which it will encounter increasing difficulty in finding return cargoes for its vessels on certain trade routes. The resultant increases in voyages in ballast and in underloading will cause a decline in fleet utilization which in turn will restrict the growth of operating efficiency. As the new plan data indicate, however, the prospect of diminishing growth in important aspects of operating efficiency has not deterred the USSR from planning accelerated expansion of its maritime fleet and services.

I. Introduction.

During the period from the end of World War II through 1958 the greatest single obstacle to increasing the operating efficiency of the Soviet maritime cargo fleet was the composition of the fleet. Many of the vessels were overage, slow, undersized, and lacking in modern labor-saving devices. At the beginning of 1958, nearly one-third of the vessels still operated on solid fuel. With few exceptions the vessels added to the fleet from the end of the war through 1958, although new, were not modern in design. As a result, their contributions to increases in operating efficiency were limited. They were characteristically both smaller and slower than equivalent vessels added to Free World maritime fleets during the same period.

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Another explanation of the low level and slow growth of the operating efficiency of the Soviet maritime cargo fleet is that methods and equipment in such activities as cargo handling and ship handling in seaports, ship repairs, and traffic management were not entirely up to date. For this reason, Soviet efforts to raise the operating efficiency of the maritime cargo fleet extend to these activities as well as to improvement of the fleet itself.

The efforts and plans of the USSR to overcome these obstacles and to raise the operating efficiency of its maritime cargo fleet are discussed in II, below. If carried to fulfillment, this program should eliminate many of the obstacles to the growth of fleet operating efficiency which existed during the period from the end of World War II through 1958. Section III, however, which compares the actual growth of fleet operating efficiency, performance, and cargo-carrying capacity during the Fifth and Sixth Five Year Plans (1951-58) with the planned growth of the same factors during the Seven Year Plan (1959-65), indicates that the USSR anticipates no accelerated growth in the two most important indexes of fleet operating efficiency as a result of the removal of these obstacles. An explanation of this apparent paradox is provided in IV, below.

II. Efforts to Raise Operating Efficiency.

The complex of factors that influences the operating efficiency of the Soviet maritime cargo fleet includes a small number, such as the weather and geography, which the USSR can do very little to control and a large number which the USSR can do much to control, assuming a willingness to make the necessary allocations of manpower and resources. Most Soviet efforts to control the latter factors are included in the following five fields: (1) improvement of the fleet, (2) port facilities and port activity, (3) traffic management, (4) ship repair, and (5) regulation of the size and composition of crews.

A. Improvement of the Fleet.

1. Addition of Modern Vessels.

The degree of improvement of a fleet brought about by the addition of new vessels depends on the characteristics of the vessels being added. Some of the most important characteristics are the following: speed, cargo-carrying capacity, rate of fuel consumption, degree of mechanization of cargo handling aboard ship, and type of fuel burned. Each of these characteristics affects one or more aspects of fleet operating efficiency. Thus the more modern the new vessels are in terms of these characteristics, the more favorably they will affect efficiency.

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From World War II to the end of 1958 the USSR had difficulty in supplying its maritime cargo fleet with vessels the operating characteristics and equipment of which were modern by Free World standards. This statement is particularly true with regard to the tanker fleet. As of 31 December 1958, there was only one tanker in the fleet which could be considered modern in terms of either speed or cargo-carrying capacity -- the Apsheron, a tanker delivered to the USSR by Denmark in 1952. This tanker has a speed of 14.5 knots and a cargo-carrying capacity of nearly 13,000 metric tons* and can be considered modern only in terms of speed.

The Kazbek-class tankers which have been added to the fleet in considerable numbers since 1951 and which account for the bulk of the tonnage in the fleet were outmoded from the day they went into construction. They are considered to be general-purpose tankers because (unlike supertankers, the drafts of which limit the number of trade routes that the vessels can serve on) they are able to serve on all major trade routes. These Kazbek-class tankers have maximum speeds of 13.3 knots and cargo-carrying capacities of 11,000 tons, although the general-purpose tankers which were added to most Free World fleets during the same period carry up to 18,000 tons at speeds up to 16 knots. 1/**

Under the pressure of a severe shortage of tanker tonnage, the USSR was forced by Free World controls on strategic exports to build its own tankers. Although other factors may have entered, the Soviet decision to concentrate construction on the outmoded Kazbek-class model undoubtedly was influenced to a considerable extent by the lack of a powerplant suitable for a larger and faster tanker. The USSR did not have the capability to produce modern diesels larger than the 2,000-horsepower models used in the Kazbek-class, foreign manufacturers of diesels had too many orders from other sources to be able to meet Soviet needs, and Soviet turbine-producing facilities were entirely absorbed in meeting other needs.

As of December 1958 the USSR was planning the addition of two new classes of modern tankers to the fleet. One class was planned to consist of steam-turbine tankers designed to carry up to 27,000 tons of cargo at speeds up to 17.7 knots. The size of these vessels would put them almost into the supertanker category, which one authority defines as tankers with cargo-carrying capacities of 30,000 tons and more. 2/ Like the supertankers, their activity would be confined to trade routes connecting ports with depths of at least 35 feet. (Their draft loaded is planned to be 33.7 feet.) In addition to the advantages which these planned new tankers would have over those of the Kazbek class in terms of size and speed, their cargo-handling equipment would be better. The discharge pumps on these tankers would be able to empty

* Tonnages are given in metric tons throughout this report.

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a full cargo of 27,000 tons in little more than 16 hours. The pumps on the Kazbek-class tankers require 20 hours to empty a full cargo of 11,000 tons. For this reason, the introduction of these new steam-turbine tankers should help to decrease the time spent in port by the tanker fleet. The USSR expects the cost per ton-mile to be 27 percent lower on these tankers than on those of the Kazbek class and expects the labor productivity to be 27 percent higher. 3/ The first tanker of this planned class was launched during the second half of 1958. The tankers of the second class, still in the planning stage at the end of 1958, were designed to carry cargoes of 17,000 tons at speeds of 17.0 knots and apparently are intended to supersede the Kazbek-class tankers in their general-purpose role. With these characteristics and with drafts of 29.4 feet, which would enable them to enter most of the major seaports of the world, the tankers of the second class will, if built, compare favorably with recent general-purpose tankers built in the Free World. The cost of their operation is planned to be 25 percent lower than that of the Kazbek-class tankers. 4/

The Soviet tanker fleet has a great advantage over the dry cargo fleet in that it requires no shift from solid to liquid fuel. All of the new tankers acquired by the USSR since World War II have been diesel or diesel-electric propelled. Among the tankers in use during 1958, only one was a coal burner.

In the dry cargo fleet, as in the tanker fleet, the two most important effects of the addition of new vessels are the increases in average speed and in size. The introduction of vessels which are modern in terms of both speed and size into the Soviet maritime dry cargo fleet began in 1952. Through 1955, however, deliveries remained on a small scale and consisted entirely of imported vessels. The modern dry cargo vessels delivered during 1952-55 included 2 Finnish-built Arkhangel'sk-class vessels with speeds of 17.4 knots and cargo-carrying capacities of 7,200 tons and 3 Dutch-built Lena-class vessels with speeds of 14.2 knots and cargo-carrying capacities of 7,600 tons.

Deliveries of vessels of both of these classes continued into the period of the original Sixth Five Year Plan. Deliveries of the Arkhangel'sk-class vessels, which through 1958 were the most modern dry cargo vessels in the fleet in terms of size and speed, are planned to continue through 1960. 5/ It appears, however, that the Lena-class vessels delivered in 1957 were the last of their class. An improved version of these vessels designed with ice-breaking features for use along the Northern Sea Route reportedly is planned for construction in Soviet shipyards.

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The only other class of modern dry cargo vessels with cargo-carrying capacities greater than 4,000 tons imported during the first 2 years of the Sixth Five Year Plan was a series of French-built steam-turbine vessels with cargo-carrying capacities of 6,200 tons and speeds of 14.6 knots. Six were delivered, but it is not certain that the USSR will order more.

The first modern dry cargo vessels with cargo-carrying capacities greater than 4,000 tons to be built in the USSR appeared during 1956. They were the diesel-electric GES-class vessels with cargo-carrying capacities of 6,500 tons and speeds of 16.0 knots. Six of these vessels were delivered during 1956 and 1957, but it is uncertain whether or not the USSR intends to produce more.

The USSR apparently intends to continue purchases from Finland and the European Satellites of certain classes of smaller and slower dry cargo vessels with cargo-carrying capacities of less than 4,000 tons. Planned deliveries for 1958-60, however, include four classes of vessels which are modern in terms of both speed and size, as follows: (a) a collier built in East Germany with a cargo-carrying capacity of 6,300 tons and a speed of 14.5 knots; (b) the revised Lena-class icebreaker-cargo vessels with a cargo-carrying capacity of 7,500 tons and a speed of 15.0 knots; (c) a large Soviet-built, turbine-propelled dry cargo vessel with a cargo-carrying capacity of 13,000 tons and a speed of 18.6 knots; and (d) a large Polish-built, diesel-propelled dry cargo vessel with a cargo-carrying capacity of 10,000 tons and a speed of 16.8 knots. 6/ The steam-turbine vessels appear to be intended to become the mainstays of the Soviet dry cargo fleet on the longer trade routes. The USSR apparently intends to mass-produce them, for at least three were under construction at the end of 1958 without there having been any trials of a prototype.

The mechanically operated metal hatch covers on these new steam-turbine vessels, on one series of East German-built dry cargo vessels, and on the large Polish-built diesel dry cargo vessels are the only known instances of mechanization of cargo handling aboard the new vessels being added to the Soviet dry cargo fleet. The only fleet data available on this subject show that 4.5 percent of the Black Sea Steamship Company's dry cargo vessels were equipped with mechanical hatch covers in 1955. 7/ In an article published in August 1958, a deputy minister of the Ministry of the Maritime Fleet complained that the installation of mechanical hatch covers was proceeding at an inadmissibly slow rate. 8/

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2. Modernization of Existing Vessels.

The Soviet program for the modernization of existing vessels includes a variety of measures affecting operating efficiency, including the conversion of vessels from coal to fuel oil, the installation of modern radar, and the automation of boiler-combustion regulation and boiler fuel supply.

Although there is only one vessel in the Soviet tanker fleet which burns coal, more than one-third of the cargo-carrying capacity of the dry cargo fleet as of 31 December 1957 burned coal. Because coal-fired boilers require more men to operate them and tend to limit operating speeds, the USSR undertook a program during the Fifth Five Year Plan period to convert coal-burning vessels to oil burners. At the same time, plans were made to discontinue deliveries of dry cargo vessels with coal-fired boilers. This conversion program is scheduled to continue beyond 1960, and although there are no published Soviet indexes of progress in it, there is good evidence in the Soviet press and radio that the program is continuing. The USSR planned to convert a total of 34 vessels to liquid fuel during 1956-58.

The use of navigational radar on shipboard is important from the point of view of both safety and operating efficiency. A vessel equipped with this kind of radar can maintain a higher rate of speed under conditions of poor visibility than a vessel not so equipped. As of 1 January 1957, 80 percent of the vessels in the maritime fleet were equipped with navigational radar. If plans were realized, 100 percent were so equipped as of 31 December 1958. The USSR, however, will still have the problem of replacing many obsolete radar sets.

The USSR has announced another program to increase labor productivity in boiler operation. This is the automation of boiler-combustion regulation and boiler fuel supply on existing steamships. As of 31 December 1958, however, neither progress indexes nor references to specific installations had been published by the USSR.

B. Port Facilities and Methods of Handling Cargo.

The improvement of port facilities and of methods of handling cargo in the Soviet ports used by the maritime fleet influences the operating efficiency of the fleet through its effect both on the total time which a vessel spends in port and on the proportion of that time which is devoted to productive activities such as cargo handling and bunkering. In the interest of efficiency, it is desirable to reduce the total time spent in port and to increase the proportion of that time spent productively.

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The total time which each vessel spends in port is largely a function of two factors. The first factor is the number of vessels that a given port can berth at one time. One-third of the unproductive time in port is the result of vessels having to wait for berthing space. 9/ The amount of berthing space in Soviet ports thus affects the proportion of productive time in port. The second factor is the speed with which a vessel is handled once it has been berthed, the speed depending on the extent to which modern equipment and methods of handling cargo are available on the vessel and in the ports.

Thus the development of port facilities involves both increasing berthing space and introducing modern equipment and methods of handling cargo. Through 1958 the USSR was actively engaged in making both improvements. In respect to increasing berthing space, there is no index of progress available. A comparison of space added during the Fifth Five Year Plan with that planned to be added during the Seven Year Plan, however, provides an indication of the increased pace at which the USSR was planning to extend berthing space in its ports at the end of 1958. During the Fifth Five Year Plan, 4,900 linear meters of berthing space were added, consisting of both new piers and piers reconstructed after World War II. The Seven Year Plan provides for the addition of 15,500 linear meters. 10/

Among the statistical indexes which the USSR uses in its operations are two that reflect the addition of modern cargo-handling equipment by the ports. The first is the coefficient of simple mechanization, which expresses the percentage of total cargo handled in Soviet ports that is handled by processes involving mechanical devices, such as cranes or conveyers, at one or more stages of the operation. The second is the coefficient of complex mechanization, which expresses the percentage of total cargo handled that is handled by processes involving mechanical devices at all stages of the operation except for such activities as the attaching and detaching of crane hooks. 11/ The trends of these indexes through 1958 and their planned levels for 1965 are shown in Table 1.* These indexes reflect Soviet acquisition of increasing numbers of floating and shipside cranes, conveyers, forklift trucks, specialized devices for the handling of bulk cargoes such as grain and coal, and other up-to-date cargo-handling equipment. Much equipment of this kind, however, remains to be added.

The methods of handling cargo which the USSR is introducing appear to be equally up to date. The two most significant new introductions are "container" and "packet" shipments. These methods, which are especially important in the handling of piece goods and timber, have been mechanized only to a slight degree, but they represent steps in the direction of increased mechanization.

* Table 1 follows on p. 9.

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Table 1

Soviet Indexes of Levels of Simple and Complex Mechanization
of Cargo Handling in the Seaports
under the Soviet Ministry of the Maritime Fleet a/
1950-58 and 1965 Plan

<u>Percent of Total Cargo Handled</u>		
<u>Year</u>	<u>Simple Mechanization</u>	<u>Complex Mechanization</u>
1950	90.7 <u>b/</u>	<u>c/</u>
1951	92.3 <u>b/</u>	<u>c/</u>
1952	93.6 <u>b/</u>	<u>c/</u>
1953	94.6 <u>b/</u>	<u>c/</u>
1954	95.3 <u>b/</u>	36.5 <u>b/</u>
1955	95.8 <u>b/</u>	40.5 <u>d/</u>
1956	96.9 <u>b/</u>	47.9 <u>c/</u>
1957	N.A.	48.5 <u>e/</u>
1958	96.2 <u>f/</u>	56.9 <u>f/</u>
1965 Plan	N.A.	75.0 <u>g/</u>

a. Throughout this report, data are provided for 1950 because the changes in the various indexes involved are measured from 1950 to 1958 even though they occurred during 1951-58. Likewise the changes which are planned to occur during 1959-65 are measured from 1958 to 1965.

b. 12/

c. There is no indication that this index was maintained before 1954.

d. 13/

e. 14/

f. 15/

g. 16/

In the container shipment method, piece cargoes are packed into containers, which are specially constructed weatherproof boxes with cargo-carrying capacities of from 2.5 to 4.0 tons. The main effect of these containers on fleet operations is a reduction of the time which vessels must spend in port. The use of these containers also leads to reduced operating costs in port and conceivably could lead to reduced fees in Soviet ports. The containers generally used by the Soviet maritime fleet are the same ones used by the Soviet railroads and river fleet, so that the transfer from carrier to carrier of cargoes shipped by this method is greatly expedited. Little is known of the extent to which this method is employed beyond the fact that its use as recently as 1955 was limited to specified ports on the Caspian

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and Black Seas and that in 1958 there were complaints that it had not been introduced on the important route in the Soviet Far East from Vladivostok to Petropavlovsk. 17/ There is no indication that Soviet experiments have gone as far as US experiments with this method, and there is no indication of use of the related "roll on - roll off" method, wherein semitrailers are used instead of containers.* In the US, existing vessels have been modified and new vessels designed especially to carry containers. There is no indication, at least in the Soviet maritime fleet, that the USSR intends to modify or design any vessels for shipment by the container method. For the time being the USSR appears to be content to use existing vessels as they are. The situation is similar with regard to the containers themselves. A majority of the containers in use by the Soviet maritime fleet are types which the railroads have been using for at least 10 years.

The packet shipment method has the same advantage for fleet operation as the container shipment method -- that is, to reduce the time which a vessel has to spend in port. The packet shipment method is used in the handling of both piece cargoes and timber cargoes where the logs are of standard lengths. It consists of fastening the logs or piece goods to forklift pallets with straps to form packets of uniform dimensions. In 1956 the cargo handled by this method amounted to 3 per cent of the total cargo handled in Soviet maritime ports. Under the original Sixth Five Year Plan this figure was planned to be increased to 13 percent by 1960 and was to include all cargoes suitable for handling by this method by that year. 19/

C. Traffic Management.

Two important tasks which confront the USSR in the field of maritime traffic management are the coordination of the arrivals of vessels in port with the arrivals of their intended cargoes and the solicitation of cargoes. Proper coordination of vessel and cargo arrivals is required to insure the maximum utilization of vessels, to prevent port congestion, and to reduce unproductive time in port. Solicitation of cargoes also insures the maximum utilization of vessels, as it reduces the number of voyages by vessels in ballast or with partial loads. Thus Soviet efforts in the field of traffic management should affect two important aspects of operating efficiency, the utilization and the productivity of cargo-carrying capacity.

In the field of traffic management the three most significant Soviet efforts to raise the operating efficiency of the maritime fleet

* The USSR has shown no interest in this method in its maritime operations, possibly because in US experiments it has proved to be profitable only on short hauls. 18/

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are the expansion of scheduled line operation, the implementation of the economic reorganization decrees of 1957 which set up regional economic councils, and the expansion of shipments between foreign ports. The introduction of scheduled line operation consists of the assignment of a number of vessels to a given trade route in coastal, inter-coastal, or foreign trade and their operation on that route according to schedule. Scheduled lines in 1957 included the petroleum line from the Black Sea to the Soviet Far East, a general cargo line from the Black Sea to India, and a coal and manganese line between Poti and Zhdanov on the Black Sea. The advantages which the USSR claims for this method include the following: fewer voyages in ballast, a reduction in the amount of unproductive time in port, greater operating speeds as a result of increased familiarization of the crews with the routes, reduced loading and unloading time in port as a result of increased familiarity of the crew with the specialized cargo (when it is specialized, as in the case of ore and coal on the Poti-Zhdanov line), and increased familiarity of the dock workers with the ships assigned to the line. ^{20/} The percentages of the total cargo volume of the Ministry of the Maritime Fleet carried by vessels in scheduled line operations during 1954-57 were as follows:

<u>Year</u>	<u>Percent of Total</u>
1954	19.8 <u>21/</u>
1955	48.2 <u>22/</u>
1956	47.0 <u>23/</u>
1957	47.3 <u>24/</u>

Although the operating efficiency of many vessels has been improved by placing them in scheduled line operation, the USSR is still faced with the problem of keeping vessels on schedule. One device used by the Ministry of the Maritime Fleet to encourage adherence to schedule is a system of penalties and bonuses. The bonuses are paid to steamship companies and shippers when vessels are loaded or unloaded ahead of schedule. The penalties are levied against the steamship companies when the vessels are late and against the shippers when the vessels have to wait beyond their scheduled departure times for deliveries of cargo.

The regional economic councils established by the economic reorganization in 1957 should contribute to the solution of Soviet problems in the field of maritime traffic management. These councils are intended to bring together representatives of the transportation and industrial enterprises of the various economic regions, thereby permitting a higher degree of coordination in their activities. For

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example, this coordination should help to alleviate the problem of getting vessel arrivals to coincide with cargo deliveries to the ports by the shippers. As of the end of 1958 the economic reorganization had not been functioning sufficiently long for any conclusive evaluation of its effect on Soviet activities in the field of maritime traffic management.

The expansion of shipments between foreign ports is intended to increase the utilization and productivity of cargo-carrying capacity by reducing the number of voyages in ballast or with partial loads. It consists largely of obtaining cargoes for Soviet vessels which otherwise would have to return either in ballast or with partial loads from the delivery of Soviet exports abroad or from the delivery of POL from the Black Sea to the Soviet Far East. Two examples of shipments between foreign ports are the movement of Indian and Chinese Communist iron ore to Rumania and Bulgaria in Soviet dry cargo vessels returning from the delivery of exports to India and Indonesia and the movement of soybeans from Communist China to West Germany in Soviet tankers returning from the delivery of POL to the Soviet Far East. Regardless of what share of the cargo available for shipment between foreign ports the USSR is able to obtain for its vessels, its success in increasing the utilization of vessels serving on trade routes where traffic is heavier in one direction than the other will always be limited ultimately by the availability of cargo.

D. Ship Repair.

The main objective of Soviet efforts in the field of ship repair is the reduction of the time which vessels of the Soviet maritime fleet have to spend in repair. Almost all of the time out of operation is spent either in repair or waiting for repair. Excessive time in repair affects efficiency by raising the cost of shipments.

There are no indexes available of the extent to which the USSR is using the latest methods and equipment for ship repair or of the extent to which the USSR intends to expand its ship-repair enterprises. However, judging from the complaints in Morskoy flot, the journal of the Ministry of the Maritime Fleet, there is considerable room for improvement. 25/ The methods by which the USSR is currently attempting to reduce the time which vessels spend in repair include the standardization of parts to facilitate the introduction of assembly line methods into ship-repair activity, the specialization of ship-repair enterprises in the manufacture of particular spare parts and components, and the encouragement of greater participation by ships' crews in repair activity.

Repair time is also being reduced as a result of the expansion of the fleet with new, modern vessels. The newness of these vessels

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reduces the necessity for repairs, and the fact that most of them are series-built, incorporating standardized parts, reduces the time required for repairs when needed. The USSR expects to keep in operation from 80 to 85 percent of the time the new types of vessels which it plans to add during the Seven Year Plan. 26/ In 1955, the most recent year for which data are available, the average tanker was in operation 65 percent of the time, and the average dry cargo vessel was in operation 70 percent of the time. 27/

E. Size and Composition of Crews.

The ratio of crew members to cargo-carrying capacity in the USSR is a function partly of fleet composition and partly of existing regulations pertaining to the size and composition of ships' crews. During the Fifth Five Year Plan (1951-55) this ratio increased slightly, in spite of the fact that improvements in fleet composition should have caused it to drop. The difficulty lay in the ship-crew regulations then in effect. In the cases of many classes of vessels, steamship companies were required to fill job positions which technological advancements or procedural changes had made unnecessary. Thus many vessels were overmanned. During 1957, in response to agitation for revision of the standard tables of organization of ships' crews, two unnecessary positions were eliminated by order of the Ministry of the Maritime Fleet. Other changes at that time authorized the "mixing of professions," a practice which had already become widespread in the Soviet river fleet. Under this practice the number of men required to operate a given vessel is reduced by training a crewman to perform tasks in one or more additional professions or specialties. Thus an oiler might be trained to fill in as a deckhand when needed. [redacted] labor productivity in the fleet of the Black Sea Steamship Company could be raised almost 5 percent by elimination of unnecessary job positions aboard ship. 28/

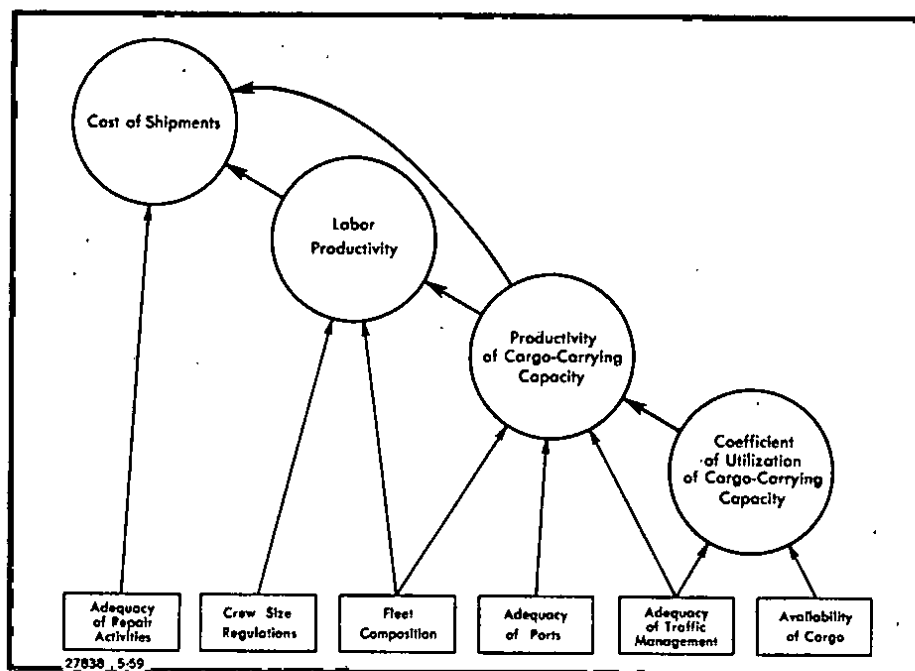
50X1
50X1III. Growth of Cargo-Carrying Capacity, Performance, and Operating Efficiency, 1951-58 and Plans for 1959-65.

In Soviet maritime shipping the chief measure of fleet capacity is cargo-carrying capacity, expressed in metric tons, and the chief measure of fleet performance is cargo turnover in ton-miles. The relationship between these two measures at any given time is a function of the operating efficiency of the fleet, particularly as manifested in the index of the productivity of cargo-carrying capacity, which is the number of ton-miles performed by a given amount of cargo-carrying capacity during a given period of time. 29/

Productivity of cargo-carrying capacity is one of four important Soviet indexes of fleet operating efficiency which are available. The

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other three are as follows: (1) cost of shipments, which measures the expenditure in kopeks for each ton-mile performed by the fleet 30/; (2) labor productivity, which is the number of ton-miles performed for each worker employed directly in the transportation process during a given period of time 31/; and (3) the coefficient of utilization of cargo-carrying capacity, which expresses the percentage ratio of ton-miles actually performed to tonnage-miles. (Tonnage-miles represent the ton-miles which would be performed if all vessels were loaded to full cargo-carrying capacity while they were under way.) 32/ Each of these indexes is influenced by one or more of the following: fleet composition, the adequacy of ports in handling vessels and cargoes, regulations regarding the size and composition of ships' crews, the adequacy of ship-repair activities, the adequacy of traffic-management activities, and the various factors other than traffic management which influence the availability of cargoes. This influence may be direct or indirect, through the effect on a given index of one or more of the other indexes. The accompanying chart shows how these indexes are influenced by one another and by the factors cited above.



Indexes of operating efficiency in the Soviet Maritime Cargo Fleet and influencing factors.

From this chart it can be seen that the cost of shipments is the most comprehensive index of operating efficiency because it is influenced by all of the other indexes and by all of the factors influencing them. Unfortunately its value is reduced by the fact that it sometimes reflects more than the operating efficiency of the fleet. Changes in the prices of the various elements of cost, such as wages, fuel, and amortization, as well as changes in the relative shares of these ele-

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ments in the whole, can cause the index to change also. Table 2 shows this index for 1950-58 and its planned level for 1965.

Table 2

Cost of Shipments
in the Soviet Maritime Cargo Fleet
1950-58 and 1965 Plan

<u>Year</u>	<u>Cost per Ton-Mile (Kopeks)</u>	<u>Change from Previous Year (Percent)</u>
1950	6.93 <u>a/</u>	N.A.
1951	N.A.	N.A.
1952	N.A.	N.A.
1953	6.30 <u>b/</u>	N.A.
1954	6.25 <u>a/</u>	-0.8
1955	5.50 <u>a/</u>	-12.0
1956	4.95 <u>a/</u>	-10.0
1957	N.A.	-4.3 <u>c/</u>
1958	4.53 <u>d/</u>	-4.3 <u>c/</u>
1965 Plan	3.44 <u>e/</u>	

a. 33/b. 34/

c. An average figure based on the change from 1956 to 1958.

d. 35/e. 36/

Because the cost of shipments tends to reflect the influence of factors other than efficiency, productivity of cargo-carrying capacity is probably the best over-all index of efficiency available. It is obtained by dividing the ton-miles performed by the fleet by the total tonnage-days in operation of the vessels of the fleet. Tonnage-days in operation are obtained by multiplying the cargo-carrying capacity of each ship by the number of days it was in operation during the time period in question. This index is influenced by the coefficient of utilization of cargo-carrying capacity and all of the factors which affect that index, by fleet composition, and by adequacy of ports. Productivity of cargo-carrying capacity in turn exerts considerable influence on both the cost of shipments and labor productivity. Table 3* shows this index for 1950-57. No plan figures for 1965 are available, because no figures for 1958 are available from which to calculate them.

* Table 3 follows on p. 16.

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Table 3

Productivity of Cargo-Carrying Capacity
in the Soviet Maritime Cargo Fleet a/
1950-58

Year	Tanker Fleet		Dry Cargo Fleet		Combined Fleet	
	Productivity (Ton-Miles per Tonnage-Day in Operation)	Change from Previous Year (Percent)	Productivity (Ton-Miles per Tonnage-Day in Operation)	Change from Previous Year (Percent)	Productivity (Ton-Miles per Tonnage-Day in Operation)	Change from Previous Year (Percent)
1950	68.6	N.A.	44.0	N.A.	49.3	N.A.
1951	73.4	7.0	46.2	5.0	52.5	6.5
1952	74.3	1.2	47.0	1.7	52.9	0.8
1953	72.5	-2.4	49.1	4.5	54.2	2.5
1954	80.2	10.6	52.9	7.7	59.3	9.4
1955	98.1	22.3	52.0	-1.7	62.2	4.9
1956	105.1	7.1	54.2	4.2	67.1	7.9
1957	103.0 b/	-2.0	58.0 b/	7.0	71.9 b/	7.2
1958	N.A.	N.A.	61.9 c/	6.7	N.A.	N.A.

a. See Table 7, p. 24, below, for data for 1950-57.

b. Plan data only.

c. 37/

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The next index in importance is the coefficient of utilization of cargo-carrying capacity. This index is important because of its influence on all of the other indexes. Its value as an over-all index of efficiency is limited because it is influenced only by the adequacy of traffic management activities and by the various other factors which influence the availability of cargo. Table 4 shows this index for 1950-57. No plan figures for 1965 are now available.

Table 4

Coefficient of Utilization of Cargo-Carrying Capacity
of the Soviet Maritime Cargo Fleet a/
1950-57

Year	Percent		
	Tanker Fleet	Dry Cargo Fleet	Combined Fleet
1950	51.3	58.9	56.5
1951	52.6	57.8	56.1
1952	53.9	56.9	55.9
1953	52.6	57.7	56.1
1954	55.9	60.6	59.0
1955	59.7	58.0	58.5
1956	61.9	60.5	61.0
1957 <u>b/</u>	56.1	60.4	58.4

a. See Table 8, p. 25, below.

b. Plan data only.

Labor productivity is probably the least important of the four indexes discussed. It influences only one of the other indexes -- the cost of shipments, 25 percent of which represented labor costs in 1955. 38/ In addition, labor productivity is to a large extent only another expression of productivity of cargo-carrying capacity, which exerts considerable influence on it. Labor productivity, however, also expresses the influence of fleet composition and of regulations regarding the size and composition of ships' crews on the number of men required to operate a given amount of cargo-carrying capacity in the fleet. Thus it is possible that the growth of this index during any given period of time could be greater or less than the growth of productivity of cargo-carrying capacity because of changes in the conditions determining the number of men required to operate a given

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amount of cargo-carrying capacity. Table 5 shows this index for 1950-56. Only relative growth figures are available for later years.

Table 5

Labor Productivity in the Soviet Maritime Cargo Fleet a/
1950-56

<u>Year</u>	<u>Thousand Ton-Miles per Man-Year</u>	<u>Change from Previous Year (Percent)</u>
1950	873.1	N.A.
1951	811.6	-7.0
1952	836.4	3.1
1953	847.7	1.4
1954	930.3	9.7
1955	1,043.1	12.1
1956	1,165.6	11.7

a. 39/

The planned average annual rates of growth of labor productivity and a number of other factors are available for the Seven Year Plan (1959-65). A comparison of these planned rates with the actual average annual rates of growth for the same indexes during the preceding 8-year period (1951-58) reveals some significant contrasts. These two sets of rates are presented in Table 6.* The coefficient of utilization of cargo-carrying capacity is omitted for two reasons: the rate of growth of a coefficient cannot be measured in the same way as the rates of growth of the other factors, and even if it could be measured in this way, no Seven Year Plan figures have been released for this particular coefficient.

In spite of the considerable increase in the rate of growth of cargo-carrying capacity, no increase is planned in the rate of growth of cargo turnover. The decreased rate of growth of operating efficiency that is reflected in both productivity of cargo-carrying capacity and cost of shipments is consistent with this situation. The slight rise in the rate of growth of labor productivity can be explained by the fact that it is influenced by factors other than the productivity of cargo-carrying capacity. Because of their greater size and greater use of labor-saving devices, the new vessels planned

* Table 6 follows on p. 19.

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Table 6

Average Annual Rates of Change in Important Indexes
of Cargo-Carrying Capacity, Cargo Turnover, and Operating Efficiency
in the Soviet Maritime Cargo Fleet
1951-58 and 1959-65 Plan

Years	Average Annual Rate of Change (Percent)					
	Indexes of Operating Efficiency					
	Cargo-Carrying Capacity	Cargo Turnover	Tanker Fleet	Dry Cargo Fleet	Cost of Shipments	Labor Productivity
1951-58	5.6 <u>a/</u>	13.0 <u>b/</u>	6.0 <u>c/</u>	4.4 <u>d/</u>	-5.2 <u>e/</u>	4.9 <u>f/</u>
1959-65 Plan	10.4 <u>g/</u>	12.1 <u>h/</u>	2.6 <u>i/</u>	3.8 <u>i/</u>	-3.9 <u>j/</u>	5.5 <u>k/</u>

a. The cargo-carrying capacity of the Soviet maritime fleet increased 64 percent during 1951-55 40/ and another 15.6 percent during 1956-58, 41/ or an over-all increase during 1951-58 of 54.9 percent. Using the compound interest formula, the average annual rate of growth during 1951-58 was calculated to have been 5.6 percent.

b. The cargo turnover of the maritime cargo fleet in 1950 was 21.4 billion ton-miles 42/ and in 1957, 50.0 billion ton-miles. 43/ In 1958 it increased 13.6 percent, to 56.8 billion ton-miles. 44/ There was a total increase during 1951-58 of 165.4 percent, or an average annual rate of growth of 13.0 percent.

c. The average annual rate of growth for 1951-57 was projected for 1958 because there are no productivity figures available for the tanker fleet for that year. The increase for 1951-57 was 50.0 percent (see Table 3, p. 16, above), or an average annual rate of growth of 6 percent.

d. Productivity in the dry cargo fleet increased 40.7 percent during 1951-58 (see Table 3, p. 16, above), or an average annual rate of growth of 4.4 percent.

e. The cost of shipments dropped 35 percent during 1951-58 (see Table 2, p. 15, above), or an average annual rate of change of -5.2 percent.

f. Because no labor productivity figures are available for 1957-58, the average annual rate of growth for 1951-56 was projected for those years. The increase for 1951-56 was 33.5 percent (see Table 5, p. 18, above), or an average annual rate of growth of 4.9 percent.

g. The planned increase in cargo-carrying capacity for this period is nearly 100 percent, or an average annual rate of growth of 10.4 percent. 45/

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Table 6

Average Annual Rates of Change in Important Indexes
of Cargo-Carrying Capacity, Cargo Turnover, and Operating Efficiency
in the Soviet Maritime Cargo Fleet
1951-58 and 1959-65 Plan
(Continued)

-
- h. The planned increase in cargo turnover is 122 percent, or an average annual rate of growth of 12.1 percent. 46/
- i. The planned increases in productivity of cargo-carrying capacity in the tanker and dry cargo fleets are 20 and 30 percent, respectively, or average annual rates of growth of 2.6 and 3.8 percent, respectively. 47/
- j. The planned decrease is 24 percent, or an average annual rate of change of -3.9 percent. 48/
- k. The planned increase is 45 percent, or an average annual rate of growth of 5.5 percent. 49/

for addition to the fleet during the Seven Year Plan will reduce the number of men required to operate a given amount of cargo-carrying capacity. If the USSR continues to bring its regulations regarding the size and composition of ships' crews up to date, this activity should have similar results.

Because the behavior of the index of the cost of shipments can be explained largely by the influence exerted on it by the index of the productivity of cargo-carrying capacity, the behavior of the latter index should be examined more closely in attempting to explain the planned reduction in the rate of growth of cargo turnover at a time when the rate of growth of cargo-carrying capacity is increasing. Another reason for examining this index is to explain the reduction in the rate of growth of productivity at a time when the large numbers of large modern dry cargo vessels and tankers planned for addition to the fleet should be expected to raise productivity of cargo-carrying capacity. In IV, below, the factors influencing the productivity of cargo-carrying capacity are examined with the intention of explaining the unusual behavior of this index.

IV. An Explanation of the Planned Decrease in the Rate of Growth of Productivity of Cargo-Carrying Capacity, 1959-65.

The most direct way to determine the reason for the planned decrease in the rate of growth of productivity of cargo-carrying capacity in the USSR is to examine systematically the factors of which it is a function. The following factors affect productivity directly: fleet composition, adequacy of ports, utilization of cargo-carrying capacity, and adequacy of traffic management. Productivity is affected

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indirectly by the factors which affect utilization of cargo-carrying capacity -- including the coefficients of voyages in ballast and loading -- and various other factors -- including Soviet activities in the field of traffic management -- which influence the availability of cargo.

In the case of both fleet composition and port adequacy, all indications are that the rate of growth of productivity should increase. During the Seven Year Plan period, large numbers of truly modern ships are to be added to the fleet for the first time, and port capacity is to be raised considerably, both by the expansion of facilities and by improvements in equipment and methods.

Although no figures have been announced for the changes which are planned to occur during the Seven Year Plan period in the coefficient of utilization of cargo-carrying capacity, there is considerable evidence that it is planned to drop and that in this planned decrease lies the explanation for the decrease in the rate of growth of productivity of cargo-carrying capacity.

There is actually evidence that such a drop was foreseen by the USSR at the time plan figures for 1957 were released. Although little change was planned in the utilization of the dry cargo fleet for that year, the coefficient of utilization for the tanker fleet was planned to drop from 61.9 to 56.1 percent.

To understand the circumstances which might lead to such a drop in the utilization of cargo-carrying capacity, it is necessary to consider two lesser indexes which influence it. These are the coefficient of voyages in ballast, which expresses the ratio between the number of voyages made without cargo and the number of voyages made with cargo, and the coefficient of loading, which expresses the ratio between the tonnage of cargo actually carried on the voyages made with cargo and the tonnage of cargo which would have been carried if all the ships involved had been loaded to full cargo-carrying capacity. The level of these indexes depends largely on the ability of the USSR to find return cargoes for its vessels. The declines planned in 1957 in both the productivity of cargo-carrying capacity and the coefficient of utilization for the tanker segment of the fleet reflect the anticipation of increasing difficulty in the procuring of return cargoes for Soviet tankers. The reason for this trend is to be found in the program of the USSR to increase its seaborne foreign trade and the role of its tankers and dry cargo vessels in the movement of such trade. The first year in which there was a significant rise in Soviet POL shipments in foreign trade was 1956. The bulk of the increase consisted of exports from the Black Sea area in Soviet tankers. The rise in these exports during 1955-58 is shown in the following tabulation:

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<u>Year</u>	<u>Thousand Metric Tons</u> <u>50/</u>	<u>Change from Previous Year (Percent)</u>
1955	155	N.A.
1956	1,029	564
1957	3,327	223
1958	5,342	61

Because of the preponderance of export shipments and because tankers are normally capable of carrying only liquid cargoes and a limited number of bulk dry cargoes such as soybeans and grain, many of the Soviet tankers which delivered these exports had to return to the USSR in ballast. Some of the tankers returning from deliveries to Western Europe were able to load crude oil in Albania for the last legs of their return voyages, but the majority were required to remain in ballast for the entire distance.

Such problems existed in milder form long before the present trade offensive began. Numerous coastal and intercoastal trade routes exist, involving only Soviet ports, on which there are considerable numbers of voyages in ballast or with undercapacity loadings. This statement is borne out by the fact that neither the coefficient of utilization for the tanker fleet nor that for the dry cargo fleet has ever exceeded 62 percent during the postwar period.

The increase in the volume of foreign trade cargoes carried by Soviet vessels is planned to continue during 1959-65, although at a slower rate than during 1956-57. Shipments of POL in foreign trade are to increase by 150 percent and shipments of dry cargoes by 220 percent. 51/ Because the rate of growth for export cargoes will be so much greater than that for import cargoes,* however, the number of voyages in ballast also is expected to rise. This factor more than any other should explain the anticipated drop in the utilization of cargo-carrying capacity in the Soviet maritime cargo fleet during 1959-65. Apparently the USSR has accepted the fact that this drop will occur in spite of its efforts to improve traffic management.

* Under the original Sixth Five Year Plan the volume of import cargoes carried by Soviet vessels was planned to rise by only 18 percent during 1956-60.

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APPENDIX A

STATISTICAL TABLES

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Table 7

Derivation of the Productivity
of Cargo-Carrying Capacity of the Soviet Maritime Cargo Fleet
1950-57

Year	Tanker Fleet			Dry Cargo Fleet			Combined Fleet		
	(1) Productivity (Ton-Miles per Tonnage-Day in Operation)	(2) Turnover (Billion Ton-Miles)	(3) Ship Time a/ (Million Tonnage-Days in Operation)	(4) Productivity (Ton-Miles per Tonnage-Day in Operation)	(5) Turnover (Billion Ton-Miles)	(6) Ship Time b/ (Million Tonnage-Days in Operation)	(7) Productivity c/ (Ton-Miles per Tonnage-Day in Operation)	(8) Turnover d/ (Billion Ton-Miles)	(9) Ship Time e/ (Million Tonnage-Days in Operation)
1950	68.6 f/	6.4 g/	93.3	44.0 f/	15.0 g/	340.9	49.3	21.4	434.2
1951	73.4 f/	7.0 g/	95.4	46.2 f/	14.7 g/	318.2	52.5	21.7	413.6
1952	74.3 f/	7.2 g/	96.9	47.0 f/	16.6 g/	353.2	52.9	23.8	450.1
1953	72.5 f/	7.5 g/	103.4	49.1 f/	18.3 g/	372.7	54.2	25.8	476.1
1954	80.2 f/	9.6 g/	119.7	52.9 f/	20.8 g/	393.2	59.3	30.4	512.9
1955	98.1 f/	12.9 g/	131.5	52.0 f/	24.1 g/	463.5	62.2	37.0	595.0
1956	105.1 h/	17.6 g/	167.5	54.2 h/	26.6 g/	490.8	67.1	44.2	658.3
1957	103.0 h/	22.0 i/	213.6	58.0 h/	27.6 j/	475.9	71.9	49.6	689.5

a. Column 2 divided by column 1.

b. Column 5 divided by column 4.

c. Column 8 divided by column 9.

d. Sum of columns 2 and 5.

e. Sum of columns 3 and 6.

f. 52/

g. 53/

h. 54/

i. 54/

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Table 8

Derivation of the Coefficient of Utilization
of the Cargo-Carrying Capacity of the Soviet Maritime Cargo Fleet
1950-57

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Tanker Fleet			Dry Cargo Fleet			Combined Fleet		
	Turnover a/ (Billion Ton-Miles)	Coefficient of Utilization (Percent)	Ship Movement b/ (Billion Tonnage-Miles)	Turnover c/ (Billion Ton-Miles)	Coefficient of Utilization (Percent)	Ship Movement d/ (Billion Tonnage-Miles)	Turnover e/ (Billion Ton-Miles)	Coefficient of Utilization f/ (Percent)	Ship Movement g/ (Billion Tonnage-Miles)
1950	6.4	51.3 h/	12.5	15.0	58.9 h/	25.4	21.4	56.5	37.9
1951	7.0	52.6 h/	13.3	14.7	57.8 h/	25.4	21.7	56.1	38.7
1952	7.2	53.9 h/	13.4	16.6	56.9 h/	29.2	23.8	55.9	42.6
1953	7.5	52.6 h/	14.3	18.3	57.7 h/	31.7	25.8	56.1	46.0
1954	9.6	55.9 h/	17.2	20.8	60.6 h/	34.3	30.4	59.0	51.5
1955	12.9	59.7 h/	21.6	24.1	58.0 h/	41.6	37.0	58.5	63.2
1956	17.6	61.9 i/	28.4	26.6	60.5 i/	44.0	44.2	61.0	72.4
1957	22.0	56.1 j/	39.2	27.6	60.4 k/	45.7	49.6	58.4 j/	84.9

a. From column 2, Table 7, p. 24, above.

b. Column 1 divided by column 2.

c. From column 5, Table 7, p. 24, above.

d. Column 4 divided by column 5.

e. Sum of columns 1 and 4.

f. Column 7 divided by column 9.

g. Sum of columns 3 and 6.

h. 56/

i. 57/

j. Plan data only.

k. 58/

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APPENDIX B

METHODOLOGY

This report is based almost entirely on Soviet material dealing with the operation of the Soviet maritime cargo fleet. This material was first surveyed to identify the indexes which the USSR uses to measure the operations of the fleet. It was then determined that four of these indexes could be considered to be indexes of operating efficiency. Each index expressed a ratio between cargo turnover in ton-miles, which are considered to be the main units of production in Soviet maritime shipping, and one of the following: operating cost, cargo-carrying capacity, and the size of the labor force. Soviet handbooks and glossaries in the field of maritime shipping and in the related field of river shipping were consulted to establish precise definitions and formulas for each of the indexes. After further study of Soviet shipping journals for information on the nature and extent of Soviet efforts to improve these indexes, the relationships between these efforts and the various indexes were analyzed to determine the factors influencing each of the indexes.

Using similar material, as much information as possible was assembled for the creation of time series for the various indexes. The time series for two of the indexes for the entire fleet had to be derived from separate data on the dry cargo fleet and the tanker fleet. Fortunately, the weighting factors necessary for the derivation were available.

In order to obtain average annual rates of change for fleet capacity, performance, and operating efficiency for purposes of comparison, the actual over-all percentage increases during 1951-58 and the planned over-all percentage increases for the indexes involved were used to derive the average annual rates during the same periods by the compound interest formula.

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